Stream Diversions

Final TCRA Work Plan

pursuant to

Administrative Settlement and Order on Consent for Removal Actions

(CERCLA Docket No. 10-2021-0034)

Prepared by

Perpetua Resources

With revisions regarding selected design alternatives by:

U.S. Environmental Protection Agency Region 10

United States Department of Agriculture Forest Service Intermountain Region

Stibnite Mine Site

Stibnite, Valley County, ID

July 2021

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ABBREVIATION	DESCRIPTION
%	Percent
yd^3	Cubic yard (s)
µg/L	Microgram(s) per liter
AMSL	Above mean sea level
ARAR	Applicable and Relevant or Appropriate Requirement
ASAOC	Administrative Settlement Agreement and Order on Consent
BMC	Bradley Mining Company
BMP	Best management practice
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
cfs	Cubic foot (feet) per second
COVID-19	Coronavirus Disease 2019
CY	Cubic yard
DMEA	U.S. Defense Mineral Exploration Administration
ECO	Engineering Change Order
EFSFSR	East Fork of the South Fork of the Salmon River
EPA	U.S. Environmental Protection Agency
EPP	Environmental Protection Plan
FHWA	Federal Highway Administration
ft	Foot (feet)
ft/ft	Foot (feet) per foot (feet)
Hecla	Hecla Mining Company
HP	Horsepower
in.	Inch(es)
IDEQ	Idaho Department of Environmental Quality
MCFZ	Meadow Creek Fault Zone
MGII	Midas Cold Idaho Inc.

MSE	Millennium Science, and Engineering, Inc.
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
QAPP	Quality Assurance Project Plan
RAO	Removal action objective
RIO ASE	Rio Applied Science & Technology
SGP	Stibnite Gold Project
SODA	Spent ore disposal area
TCRA	Time Critical Removal Action
USDA-FS	U.S. Department of Agriculture Forest Service
WQSR	Water Quality Summary Report

1 EXECUTIVE SUMMARY

Respondents Perpetua Resources Corp., Perpetua Resources Idaho, Inc. (formerly Midas Gold Corp. and Midas Gold Idaho, Inc. Respectively), Idaho Gold Resources Company, LLC and Stibnite Gold Company ("Perpetua") prepared a work plan for implementing a Time Critical Removal Action (TCRA) to divert upgradient surface water around three historical mine features at the Stibnite Mine (Project Area or Site) in Valley County, Idaho (refer to Figure 2-1) (Perpetua, 2021). This final TCRA Work Plan has been revised by the U.S. Environmental Protection Agency (EPA) and focuses on the selected design alternative. Perpetua Respondents are implementing the TCRA in accordance with the requirements of an Administrative Settlement Agreement and Order on Consent (ASAOC) for Removal Actions with EPA and U.S. Department of Agriculture Forest Service (USDA-FS or Forest Service) (EPA and USDA-FS, 2021a). The work is being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

The purpose of this final Work Plan is to present the selected design alternatives for the TCRA that best satisfies the design considerations and removal action objectives (RAOs) used to evaluate the potential design alternatives presented in the Revised Stream Diversions TCRA Work Plan (Perpetua 2021).

The TCRA projects addressed in this Work Plan include construction of surface water diversions around the following sources of metals contamination to receiving streams in the Project Area.

- **Northwest Bradley Waste Rock Dumps** – These mine waste dumps include approximately 2,187,000 cubic yards of material, located on a hillside above the East Fork of the South Fork Salmon River (EFSFSR) as well as within the floodplain of the stream, and consist of a variety of materials ranging in size from silt to boulder. Hennessy Creek is a perennial tributary to the EFSFSR, entering from the southwest, which was previously intercepted and routed around this source area through a constructed diversion west of the dumps and along Stibnite Road, ultimately reporting to the EFSFSR near its confluence with Sugar Creek. This diversion remains but loses water, which is believed to flow through the Northwest Bradley dumps and thereby transports metals to the EFSFSR. The goal of the TCRA is to reduce metals loading to the EFSFSR by re-establishing an effective diversion of Hennessy Creek that reduces or eliminates leakage into the Northwest Bradley dumps.
- **U.S. Defense Mineral Exploration Administration (DMEA) Waste Rock Dump** – This dump, with an estimated volume of 10,000 CY of mine waste materials of varying grain sizes, is located within a small, unnamed tributary valley west of the EFSFSR. The DMEA Adit is also located at the top of the dump, and issues metals-impacted water into the unnamed drainage, via seeping into the DMEA waste dump, potentially leaching additional metals along its pathway, before ultimately entering shallow groundwater or seeping out the toe of the dump and combining with surface water. In concept, the unnamed tributary would be diverted around this dump in a lined conveyance, reducing the impact of this source on the receiving stream.
- **Smelter Flats / Hangar Flats** – This deposit is comprised of thousands of cubic yards of buried smelter and mineral processing waste and is located along Meadow Creek, a tributary to the EFSFSR that enters from the southwest near the southern end of the Project Area. Water that enters the Meadow Creek drainage from an unnamed drainage from the northwest through a leaky ditch would be captured in this diversion and routed around the upper portion of this source area and into Meadow Creek via the keyway marsh, re-establishing the function of a previously filled ditch and reducing the impact on the quality of water in the stream.

These source areas have been present in the Project Area for decades and are relics of mine waste disposal practices of former operators. The source areas are generally composed of broken rock and other wastes of varying grain sizes that contain metals available to leaching when in contact with water and/or that can be transported in suspension. Metals of particular concern are arsenic, antimony, and mercury, which are also present naturally in areas undisturbed by mining activities but are potentially less susceptible to mobilization through contact with surface runoff or streamflow relative to disturbed materials which have enhanced surface area and potential for mobilization.

The objective in preparing this Work Plan is to select the TCRA design alternatives for these three locations and, following construction, reduce these inputs of various metal contaminants to the primary drainage in the area, the EFSFSR and certain tributaries. The primary mechanism that is currently responsible for movement of such contaminants from these source areas is neutral metal leaching of arsenic and antimony in subsurface water in contact with mine waste, and transport of these metals in dissolved form via groundwater. As some of the source areas are partially covered by soil and/or vegetation and feature flat areas that capture runoff, a secondary, less frequent and less spatially extensive mechanism is particle erosion of mine waste by rainfall and snowmelt (either in active gullies or as more widespread sheet erosion during runoff events) and transport of materials in suspended or dissolved forms to the receiving stream. By capturing the surface water upstream (upgradient) of these source areas and directing the water past the source areas in engineered diversions to prevent direct contact, the expectation is that water quality in the EFSFSR will improve.

The magnitude of improvement that will be realized through construction and management of these diversions is unknown, but it is likely that most water quality standards in the EFSFSR and its tributaries, as defined in Applicable or Relevant and Appropriate Requirements (ARARs) under CERCLA, will not be met. TCRA guidance allows for such outcomes, realizing such measures are generally time critical by definition, and constructed with the intent of addressing obvious environmental problems through application of streamlined actions that will serve to improve the current situation quickly (EPA, 2009).

Several design alternatives for completing these diversion projects were evaluated. These design alternatives included using various means of transporting the captured water upstream of the source areas (e.g., pipes, lined ditches) as well as options that considered partial or complete removal of certain source areas, accompanied by reconstruction of stream channels through the removal area. These design alternatives were evaluated for effectiveness and implementability prior to EPA selection of project-specific design alternatives.

In evaluating design alternatives for the selected actions, several data gaps were identified that will be filled to support preparation of final engineering designs. These data deficiencies include the following.

Northwest Bradley Waste Rock Dumps:

- Hennessy Creek infiltration volumes and flow pathways through the Northwest Bradley dumps are poorly understood.
- Leakage from the existing Hennessy Creek diversion ditch and the potential pathways of water movement associated with legacy infrastructure (e.g., plumbing that once served Pelton wheels in structures in the Bradley pit) are poorly understood.
- Integrity of existing culverts.
- Details of topography not reflected in LiDAR surveys.

U.S. Defense Mineral Exploration Administration (DMEA) Waste Rock Dump:

- Background water quality upstream and north of the DMEA dump.

- Uncertainty of geochemical and engineering properties of waste rock material associated with the DMEA dump.
- Geotechnical stability of potential construction access.
- Details of topography not reflected in LiDAR surveys.

Smelter Flats / Hangar Flats:

- Gradation and type of material likely to be encountered in construction of the diversion, including potential presence of contaminated soils particularly in the vicinity of the former smelter stack.
- Integrity of existing culverts.
- Details of topography not reflected in LiDAR surveys.
- Background water quality in unaffected drainages.

Preliminary engineering designs have been prepared for the design alternatives; filling these data gaps to allow refinement and finalization of these designs is a high priority. A Field Sampling Plan and Quality Assurance Project Plan have been prepared to guide efforts to address these deficiencies. Data reports produced as an outcome of these field efforts will be used by project engineers to complete the designs and construction management plans.

a schedule has been developed to accomplish all the foregoing activities, as have procedures to gain Agency approval for any changes that may occur as these projects progress. The current schedule includes provisions for all needed data to fill identified gaps to be collected during the summer of 2021 with final design packages developed and approval granted from EPA and the Forest Service during the winter of 2021/2022. Construction contracts would then be bid with earth-moving commencing once snow conditions allow during the field season of 2022.

2 INTRODUCTION

Respondents Perpetua Resources Corp., Perpetua Resources Idaho, Inc. (formerly Midas Gold Corp. and Midas Gold Idaho, Inc. Respectively), Idaho Gold Resources Company, LLC and Stibnite Gold Company ("Perpetua") prepared a work plan for implementing a Time Critical Removal Action (TCRA) to divert upgradient surface water around three historical mine features at the Stibnite Mine (Project Area or Site) in Valley County, Idaho (refer to Figure 2-1) (Perpetua, 2021). This final TCRA Work Plan has been revised by the U.S. Environmental Protection Agency (EPA) and focuses on the selecting the design alternatives for the three stream diversions. Perpetua Respondents are implementing the TCRA in accordance with the requirements of an Administrative Settlement Agreement and Order on Consent (ASAOC) for Removal Actions with EPA and U.S. Department of Agriculture Forest Service (USDA-FS or Forest Service) (EPA and USDA-FS, 2021a). The work is being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

In the Stream Diversions Revised TCRA Work Plan (2021), three design alternatives were prepared for Hennessy Creek at Northwest Bradley Dumps, five design alternatives were prepared for the DMEA Waste Dump, and one design alternative was prepared for the Smelter Flats/Hangar Flats area. These design alternatives are summarized below. Design Alternative H-1 was selected by the EPA for Hennessy Creek at the Northwest Bradley Dumps, Alternative D-2 was selected by the EPA for the DMEA Waste Dump, and the sole alternative S-1 will be implemented for the Smelter Flats area. A more detailed description of the selected design alternatives and the rationale for selection is provided in Section 7.

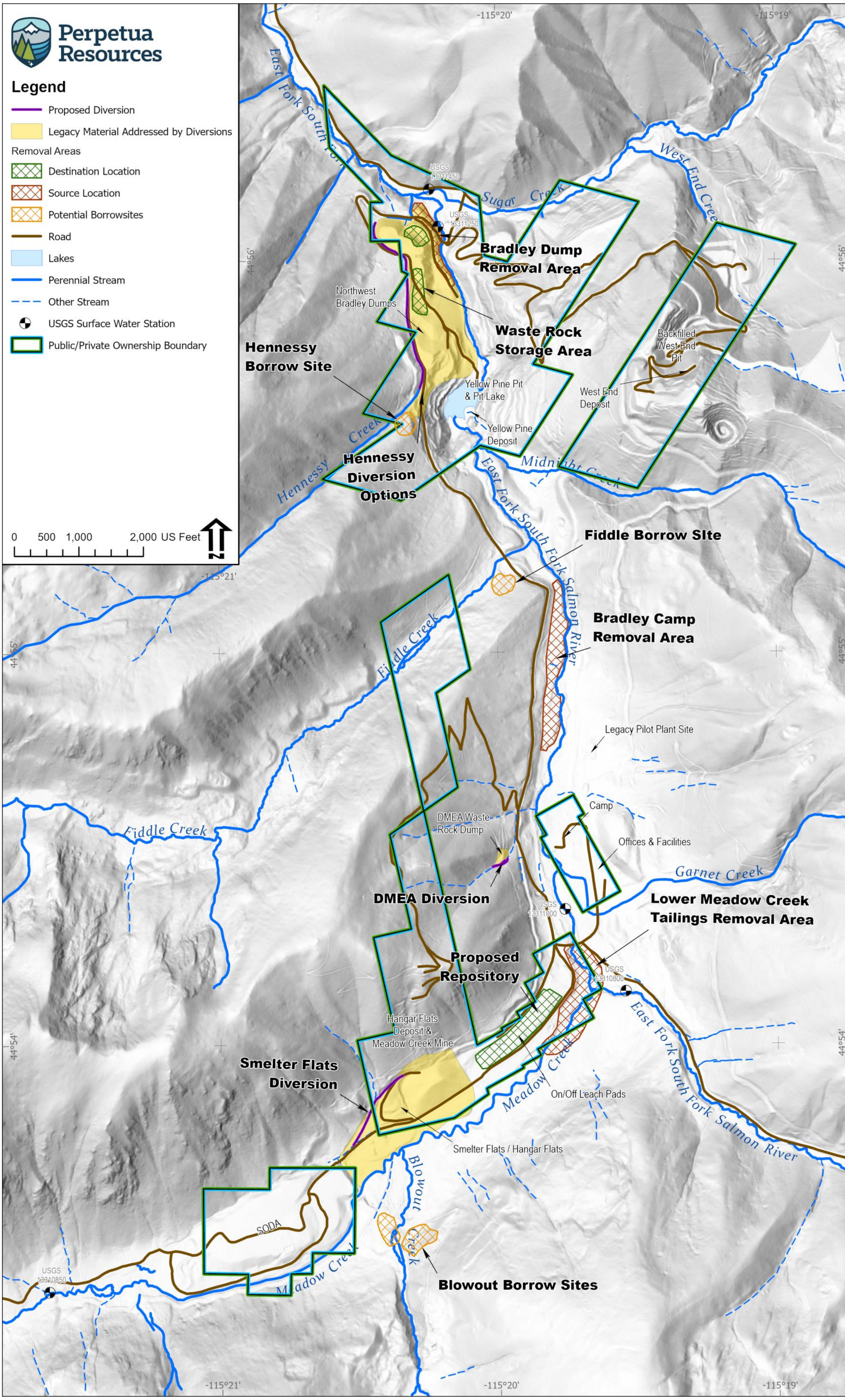

Figure 2-1 Removal Action Areas

2.1 HENNESSY CREEK AT NORTHWEST BRADLEY DUMPS

Three conceptual design alternatives were considered for the Northwest Bradley dumps stream diversion site to route Hennessy Creek around the dumps. Descriptions of these design alternatives follow.

2.1.1 Design Alternative H-1 – Improve Existing Diversion Channel Segments

Design Alternative H-1 (see Figure 2-**Error! Reference source not found.**2, and Appendix A, Sheet H-1) would improve all or part of the present Hennessy Creek diversion, which diverts water from the Hennessy Creek drainage basin along the west side of the existing Stibnite Road, ultimately crosses the road twice, and discharges to the East Fork of the South Fork of the Salmon River (EFSFSR) below Sugar Creek. The improved sections of channel would be designed to transport the 100-year flow event without erosion and include a low-permeability geosynthetic liner. The channel would be constructed in a trapezoidal shape with a bottom width of approximately 1 foot (ft), side slopes of approximately 2:1 (H:V) and a depth that would vary depending on the channel slope and discharge (water depth would range from approximately 0.9 ft to 1.6 ft).

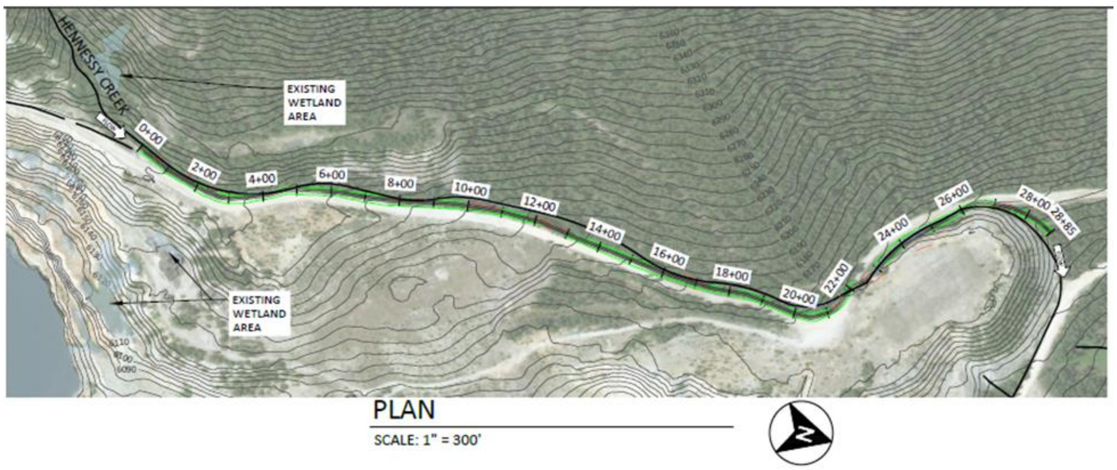

Figure 2-2 Design Alternative H-1 Plan View

From the point where Hennessy Creek is first diverted, the channel would continue to the north along the west side of the existing road for approximately 2,200 ft, at which point the channel would cross to the other side of the road where the road turns to the west. Existing culverts would be evaluated for capacity and structural stability for haul traffic (40-ton articulated dump truck), and if necessary, a new culvert(s) would replace the existing culverts at this road crossing. The diversion would continue to the northwest roughly along the current alignment between the road and dump in a new lined channel, and transition to the existing channel alongside (northwest) of the dump where the channel is no longer upgradient of mine waste. The channel would flow along the toe of the Bradley dump in the existing, unimproved diversion, and cross Stibnite Road to the north through an existing culvert.

The channel would be lined with a low permeability geomembrane and a protective layer of geotextile fabric. Seams in the liner would be made per manufacturer's recommendations. If the field investigation (Section 5) demonstrates that the same reduction in erosion protection and infiltration can be achieved with natural materials as could be provided with a geomembrane, then the detailed design for the diversion liner will be optimized. However, currently the design concept is that a minimum of 6 inches (in.) of sand/gravel would be placed on top geomembrane liner prior to the placement of riprap. In sections where the channel slope is less than 0.10 ft/ft, Federal Highway Administration (FHWA) Class 1 (5in < D_{50} < 8in) riprap may be used. Where the channel slope exceeds 0.10 ft/ft, FHWA Class 2 (8in < D_{50}

<11in) will be used. Riprap would be placed to a depth that is twice its median diameter (2* D_{50}), should have an "angular" geometry (or D_{50} adjusted accordingly) and have a specific gravity of approximately 2.65.

2.1.2 Alternative H-2 – Hennessy Creek over Bradley Pit Highwall

Under this alternative (see Figure 2-3 and Appendix A, Sheet H-2), water from the Hennessy Creek drainage basin would be diverted into a culvert to pass to the east directly under the existing Stibnite Road and discharge over the existing highwall of the Bradley pit in an open channel (chute). The new culvert and chute would be sized for the 100-year flow event and would discharge into the existing pit lake. The existing surface of the highwall would need to be prepared, shaped, and protected against erosion with shotcrete or similar. The existing Hennessy Creek diversion ditch located on the west side of Stibnite Road would be retained to allow additional runoff from the road and hillside to flow to the north.

Preparation of the highwall for the chute could require the use of light blasting to fracture the rock allowing the channel to be roughly shaped through the existing mixture of rock outcrop and loosely dumped material. Rock bolts would then be installed at approximately a 10-ft grid, and wire mesh and shotcrete applied. Steep sections of the 10 ft wide chute would have minimal flow depth (1-2 in.) and a constructed depth of approximately 1 ft. Flatter sections (on benches) would have slower and deeper flow, and potential waves, requiring additional depth and allowing for the dissipation of energy. These chute sections would have higher side walls (2-3 ft).

Figure 2-3 Alternative H-2 Plan View

2.1.3 Alternative H-3 – Combination Bradley Pit Highwall and Open Channel

This alternative combines aspects of the two previous alternatives and could be arranged with either the open channel or the overflow into the Bradley pit through a new culvert operating as the main flow route and could be built in either sequence. Either way, the highwall route into Bradley pit would be protected with shotcrete similar to Alternative H-2 and the open channel, or portions of it, along Stibnite Road would be lined with a geosynthetic and would be protected with riprap as in Alternative H-1. The preferential path would be the highwall chute, which would be sized for hundred-year flows; the retained roadside drainage ditch would not be subject to that criterion.

2.2 DMEA WASTE ROCK DUMP AREA

2.2.1 Alternative D-1 – V-Channel around Dump

Under this alternative, flow from the small upstream basin above the DMEA dump would be diverted into a V-shaped channel. The channel would be designed with capacity for the 100-year flow event, would be lined with a low-permeability geosynthetic, and protected against erosion with appropriately sized riprap. The channel would wrap around the dump and discharge into the existing natural channel downstream of the dump (Figure 2-4, and Appendix A, Sheet D-1).

The channel would be lined with a low-permeability geosynthetic with a protective layer of geotextile fabric if necessary. Seams in the liner would be made per manufacturer's recommendations. A minimum of 6 in. of sand/gravel would be placed on top of a geomembrane liner prior to the placement of riprap. FHWA Class 1 (5in < D_{50} >8in) riprap would be used; the material would be placed to a depth of 2* D_{50}, should have an "angular" geometry or appropriate increase in D_{50}, and have a specific gravity of approximately 2.65.

The new channel would be constructed primarily on the toe of the existing dump, with only minor re-shaping of the dump toe or clean fill materials required. Equipment access would require re-opening of existing roads leading to the dump toe.

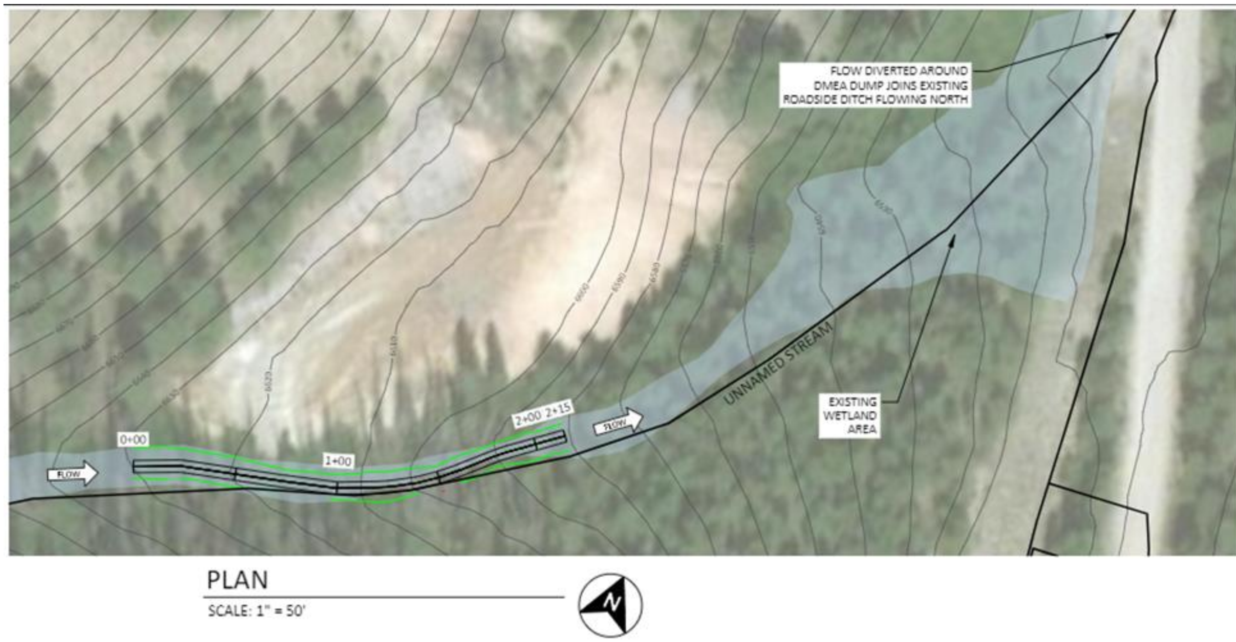

Figure 2-4 Alternative D-1 Plan View

2.2.2 Alternative D-2 – DMEA Waste Rock Dump Partial Removal

This alternative would entail partial removal of the DMEA Waste Rock Dump to allow for reconstruction of the unnamed tributary to flow in its approximate original, pre-mining alignment (see Figure 2-5, and Appendix A, Sheet C-1). This alternative would involve partial removal of the DMEA dump (total estimated at 11,000 cubic yards [CY]) with transport of the dump materials to the Northwest Bradley dumps, the same destination specified for waste removed in the Northwest Bradley Dump TCRA.

Following removal of the dump, the original land surface at the DMEA dump site would be scarified and seeded with native vegetation, potentially with mulch and/or tackifier according to slope steepness. The original channel associated with the unnamed drainage through the area would be reconstructed to mimic (in characteristics such as dimensions and sinuosity) the undisturbed portion of the channel above the current mine dump, while being stable for the 100-year discharge.

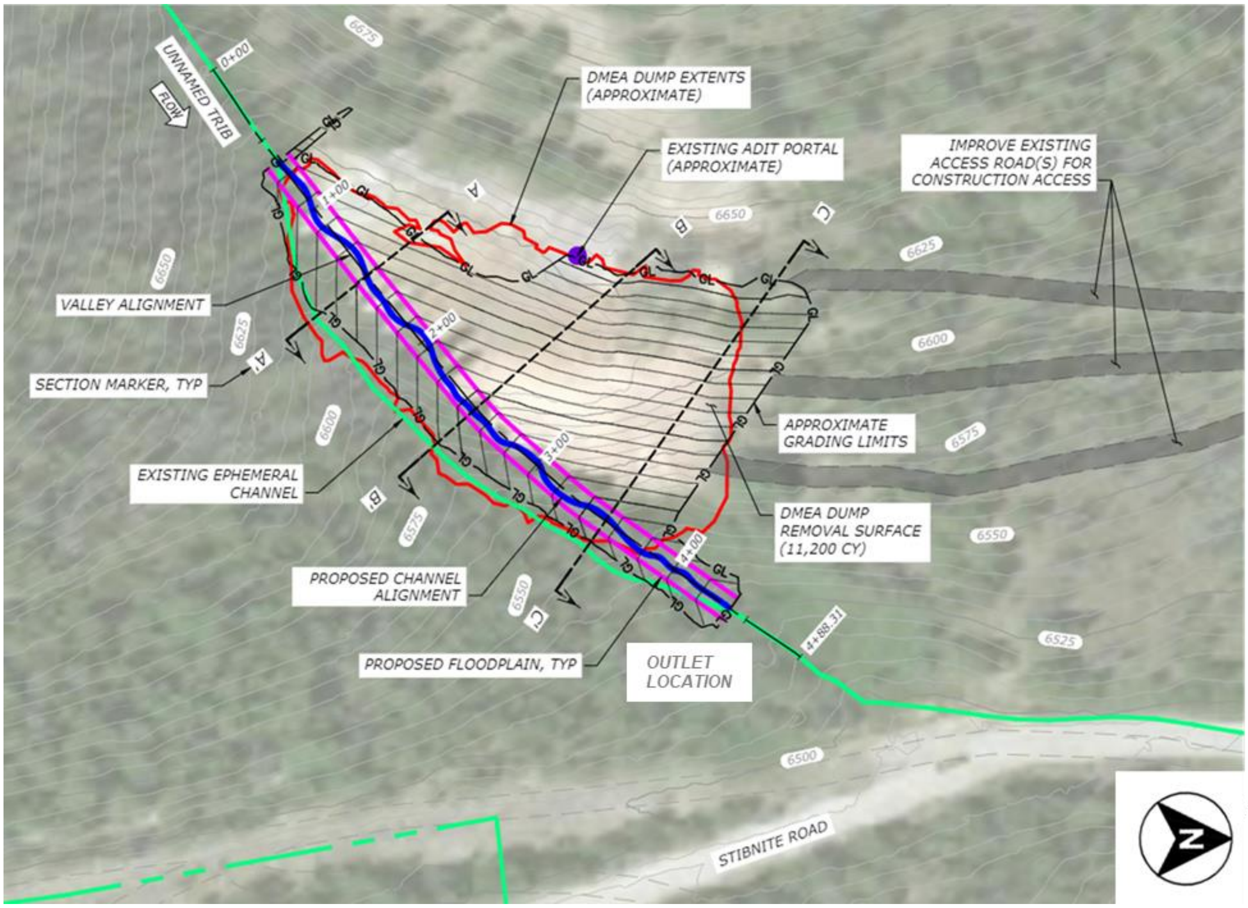

Figure 2-5 Alternative D-2 Plan View

2.2.3 Alternative D-3 – DMEA Waste Rock Dump V-Channel with Dump Re-shaping

This alternative is the same as Alternative D-1, V-Channel, but would entail reshaping of the dump to form a catch bench, addition of bank armoring, and inclusion of other slope stability improvements adjacent to the upgraded channel to reduce the potential for sloughing of mine waste materials into the channel. Although the exact volume of the dump is unknown, this alternative would likely involve reshaping of much of the DMEA dump (estimated 11,000 CY) due to steepness of pre-mining topography underlying the dump and the dump slopes being at angle of repose.

2.2.4 Alternative D-4 – DMEA Waste Rock Dump Rock Drain

Flow from the basin above the DMEA dump would be diverted into a rock drain, formed by excavating a trench into the existing ground, lined on all sides with geosynthetic and filled with approximately 6-in. diameter riprap (Appendix A, Sheet D-5). Soil removed from the trench would be used as a cover over the rock drain. The rock drain would be designed with capacity for the 100-year flow event and would be protected against existing dump material by the soil cap and the geomembrane. The rock drain would follow the same alignment as presented in Alternative D-1. The profile would be slightly lower to keep the rock drain buried.

The rock drain would be wrapped on all sides with a low-permeability geosynthetic with a protective layer of geotextile fabric if necessary. Seams in the liner will be made per manufacturer's recommendation. FHWA Class 1 (5in $<D_{50}<$8in) or smaller riprap, or similarly sized rounded rock with low fines, would be used. The channel would be constructed at or near the toe of the existing dump. No re-shaping of the dump would be required. Equipment access would require re-opening of existing roads leading to the dump toe.

2.2.5 Alternative D-5 – DMEA Waste Rock Dump V-Channel Separated from Toe

This alternative diverts flow from the existing stream above the dump into a 'V' shaped channel with the same geometry as presented in Alternative 1. Flow would continue around the dump near the toe until the slope of the dump material increases (Sta. 1+00, Figure 2-6, and Appendix A, Sheet D-5). As the slope of the dump material increases, and the risk of material falling off the dump into the channel increases, the channel alignment would move away from the dump approximately 20 to 30 ft. The alignment would continue around the dump and reconnect with the existing stream below the dump. Materials used and construction method would be identical to Alternative D-1.

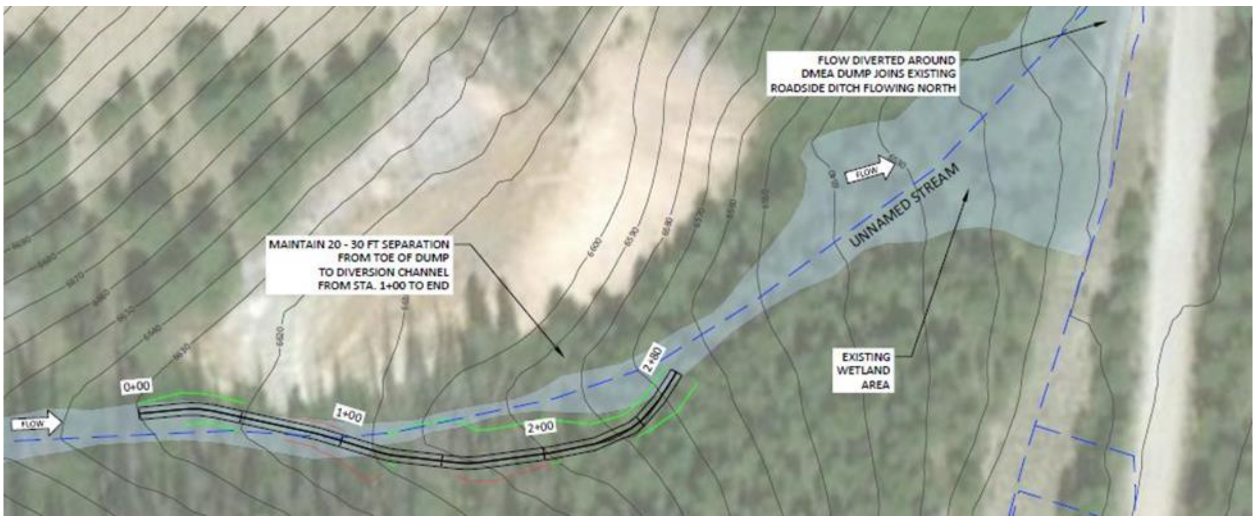

Figure 2-6 Alternative D-5 Plan View

2.3 SMELTER FLATS / HANGAR FLATS

2.3.1 Alternative S-1 – North Side Channel along Spent Ore Disposal Area (SODA) Access Road

Alternative S-1 would develop a channel along the north side of SODA access road, extending to the existing road culvert just north of Keyway Marsh (Figure 2-7, and Appendix A, Sheet S-1). This would be designed to divert the 100-year event from the small drainage basins and hillside north of the Smelter Flats area. The channel would be lined with a low permeability geosynthetic and protected with riprap against erosion. The existing culvert would be evaluated to confirm 100-year flow capacity and structural soundness for traffic loads from a 40-ton articulated dump truck and replaced, if warranted.

The channel would be lined with a low-permeability geosynthetic with a protective layer of geotextile fabric as required per subgrade conditions. Seams in the liner will be made per manufacturer's recommendations. A minimum of 6 in. of sand with gravel would be placed on top of a geomembrane liner prior to the placement of riprap. Due to the low flow and flatter slope, riprap at Smelter Flats diversion could have a D_{50} of approximately 3 in. Riprap would be placed to a depth of 2* D_{50}, should have an "angular" geometry or increased in size accordingly, and have a specific gravity of approximately 2.65.

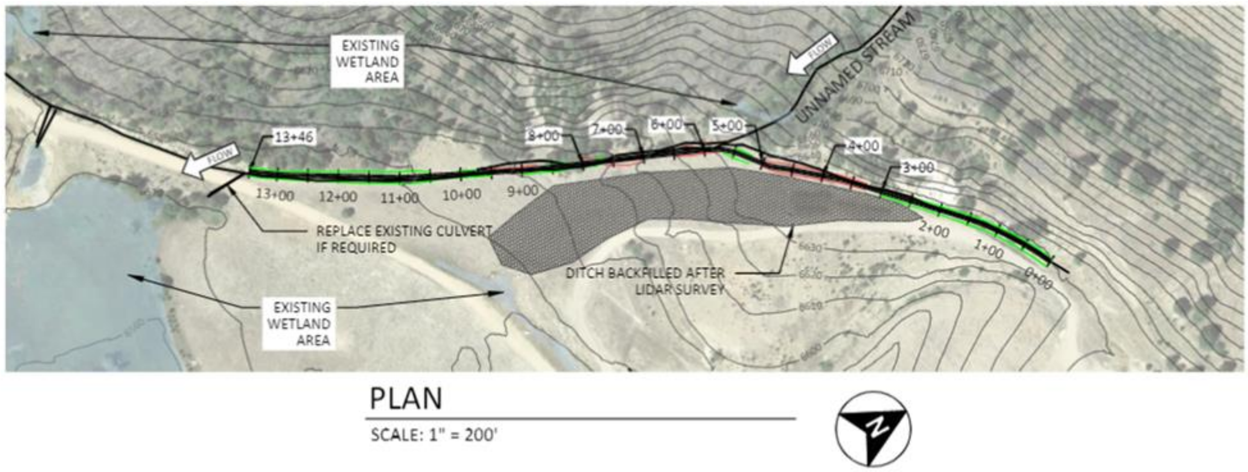

Figure 2-7 Alternative S-1 Plan View

2.4 PURPOSE

In accordance with the requirements of the ASAOC, Perpetua is conducting TCRAs to divert upgradient surface water around three historical mining features in the Project Area with the general objective of improving water quality in receiving streams and downgradient shallow groundwater. The three locations where diversions will be constructed include:

- **Northwest Bradley Waste Rock Dumps:** These 30+ acre waste rock dumps are located along the west side of the EFSFSR (Figure 2-1). Hennessy Creek is currently diverted in a channel along the west side of the waste rock dumps before flowing to the EFSFSR. Seepage from this channel likely infiltrates through the Northwest Bradley dumps and contributes the elevated metals concentrations (as compared to background conditions) measured in the EFSFSR.
- **U.S. Defense Mineral Exploration Administration (DMEA) Waste Rock Dump:** Available water quality data from this location indicates that seeps at the toe of the DMEA waste rock dump are a potential source of metals (including arsenic, antimony, and mercury) to the EFSFSR (Brown and Caldwell, 2017). This waste rock dump is located adjacent to the DMEA Adit which discharges to an unnamed perennial drainage that flows to the EFSFSR (Figure 2-1).
- **Smelter Flats / Hangar Flats:** This former mineral processing area is located near the mouth of an unnamed tributary drainage to Meadow Creek, upstream of its confluence with the EFSFSR (Figure 2-1). Water in the tributary recharges the source area, allowing groundwater and seeps emanating from this area to potentially impact water quality in Meadow Creek and the EFSFSR.

The purpose of this TCRA Work Plan is to identify the various design alternatives considered for diverting the drainages around the source areas described above, as well as present the selected design alternative that best satisfies design considerations and removal action objectives (RAOs). In addition, data gaps are identified for each of the three locations at which diversions will be constructed that will need to be filled to support the engineering design process. Other supporting information is also included herein to provide for a full understanding of the basis from which the TCRAs will proceed.

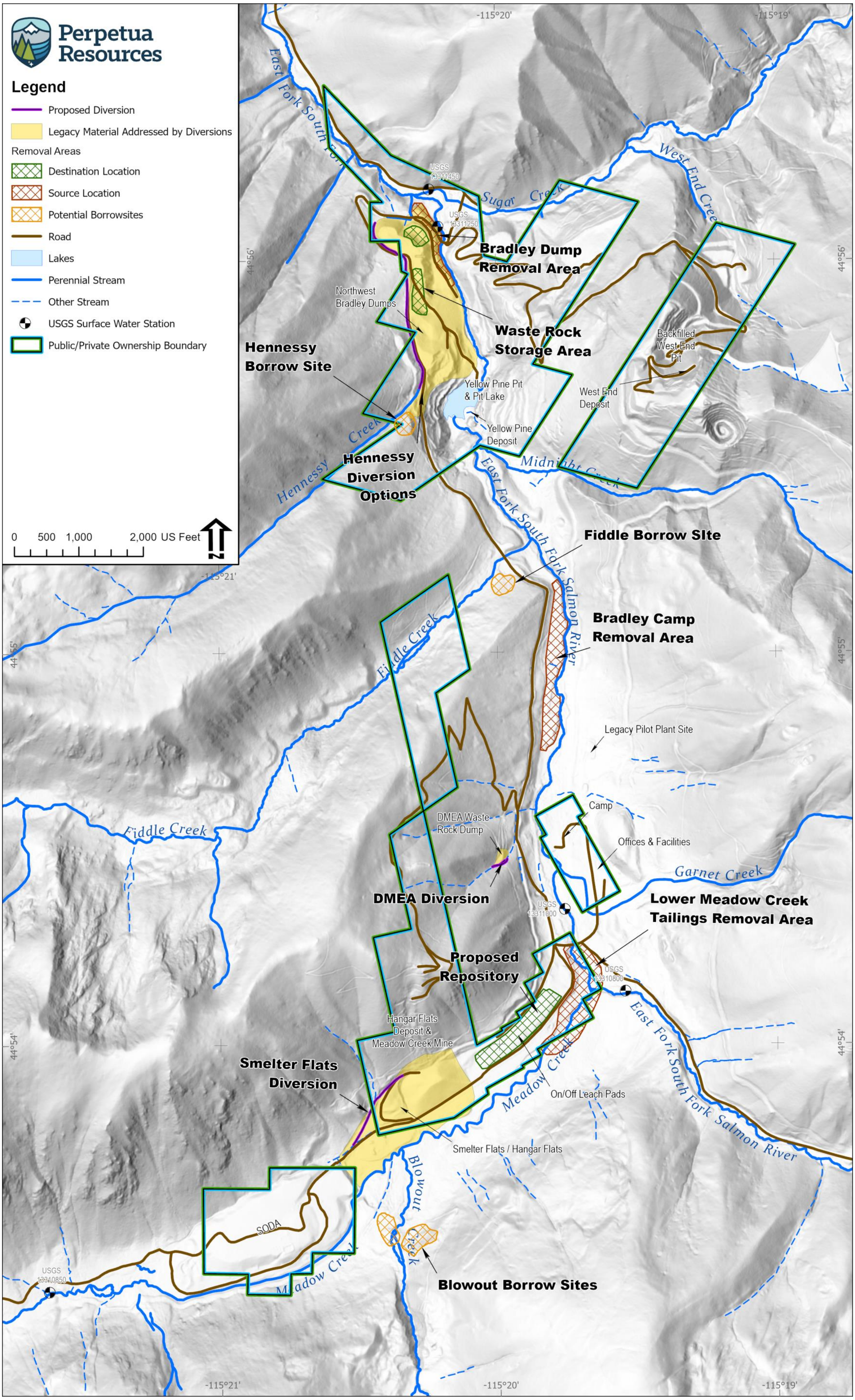

Figure 2-8 TCRA Project Areas

2.5 DOCUMENT ORGANIZATION

The remainder of this TCRA Work Plan is organized as follows:

- **Section 3** provides Site background information.
- **Section 4** summarizes available information regarding the sources and nature and extent of contamination at each stream diversion location, and identifies data needed to support the design of the removal actions.
- **Section 5** describes further data needs that will be addressed by the Field Sampling Plan.
- **Section 6** discusses Applicable or Relevant and Appropriate Requirements (ARARs).
- **Section 7** presents the selection of the design alternatives on the basis of effectiveness and implementability.
- **Section 8** presents the RAOs, basis for the design, technologies, and design alternatives.
- **Section 9** provides a schedule for implementation of the selected removal actions.
- **Section 10** describes procedures that will be followed should design changes be required and for obtaining agency (EPA and Forest Service) approval of such changes.
- **Section 11** describes procedures for complying with EPA's Off-Site Rule.

Supporting information for this TCRA Work Plan is provided in appendices, including:

- **Appendix A,** Engineering Design Documents
- **Appendix B**, Environmental Protection Plan (EPP)

3 SITE BACKGROUND INFORMATION

The Stibnite Mining district is located in Valley County, approximately 50 miles east of McCall, Idaho (Figure 3-1). The Site is located in remote, rugged, high relief terrain on a mixture of private property and public lands administered by the Forest Service. Additional information regarding the physiography, climate and precipitation, access to the Site and the mining history of the Site and surrounding area is provided in the following subsections.

3.1 PHYSIOGRAPHY

The Project Area for the TCRA sites is located within the Salmon River Mountains of central Idaho (Figure 3-1). The region consists of uplifted rocks of the Idaho Batholith deeply incised by the EFSFSR. The region is characterized by steep, rugged, and forested mountains reaching elevations of approximately 7,800 to 8,900 ft above mean sea level (AMSL). Narrow, flat valleys at an elevation of approximately 6,500 ft AMSL are present along the major drainages. Some of the highest points in the area include Cinnabar Peak (8,900 ft AMSL) along with Sugar Mountain to the north, Antimony Ridge to the west, and Indian Creek Point to the south. The lowest point (just below 6,000 ft AMSL) in the vicinity of the Project Area, is along the EFSFSR as it flows northward from the Site. The land is heavily wooded with coniferous trees and shrub understory. Large wildland fires burned much of the area in 2002, 2006, and 2007.

3.2 CLIMATE AND PRECIPITATION

The climate is characterized by moderately cold winters and mild summers. Most precipitation occurs as snowfall in the winter and rain during the spring. Weather records indicate that the average precipitation (equivalent rainfall) is approximately 32 in. per year.

3.3 SITE LOCATION AND ACCESS

The Project Area is located approximately 152 road miles northeast of Boise, Idaho (Figure 3-1). The primary access route to the Site is locally known as the Johnson Creek Route. From Boise, the Johnson Creek Route includes the following segments:

- Boise to Cascade – Highway 55 (77 miles)
- Cascade to Landmark – two-lane, paved Warm Lake Road (36 miles)
- Landmark to Yellow Pine – single-lane, unpaved Johnson Creek Road (25 miles)
- Yellow Pine to Stibnite – single-lane, unpaved Stibnite Road (14 miles).

The Johnson Creek Route is approximately 74 miles from Cascade to Stibnite and is impassable during winter months due to excessive snow depths. Alternatively, the South Fork Route provides year-round access to Stibnite in part due to a lower elevation profile. The South Fork Route follows Warm Lake Road before turning north on the South Fork Road and then turning east onto the East Fork Road towards Yellow Pine and on to the Site via Stibnite Road. The distance from Cascade to Stibnite via the South Fork Route is approximately 96 miles.

Another route available in snow-free months starts by travelling east on Lick Creek Road near McCall toward Yellow Pine and onto Stibnite (locally knowns as the Lick Creek Route). The distance from McCall to Stibnite via this access road is approximately 67 miles and from Cascade to Stibnite via McCall is approximately 94 miles. (The distance from Boise to McCall via Highway 55 is 108 miles).

The Site is also accessible via air using a grass airstrip located along Johnson Creek Road approximately three miles south of the town of Yellow Pine or using a 2,300 ft long improved gravel airstrip located at Stibnite. These airstrips are generally not used during the winter months due to the lack of snow removal equipment to maintain the facilities.

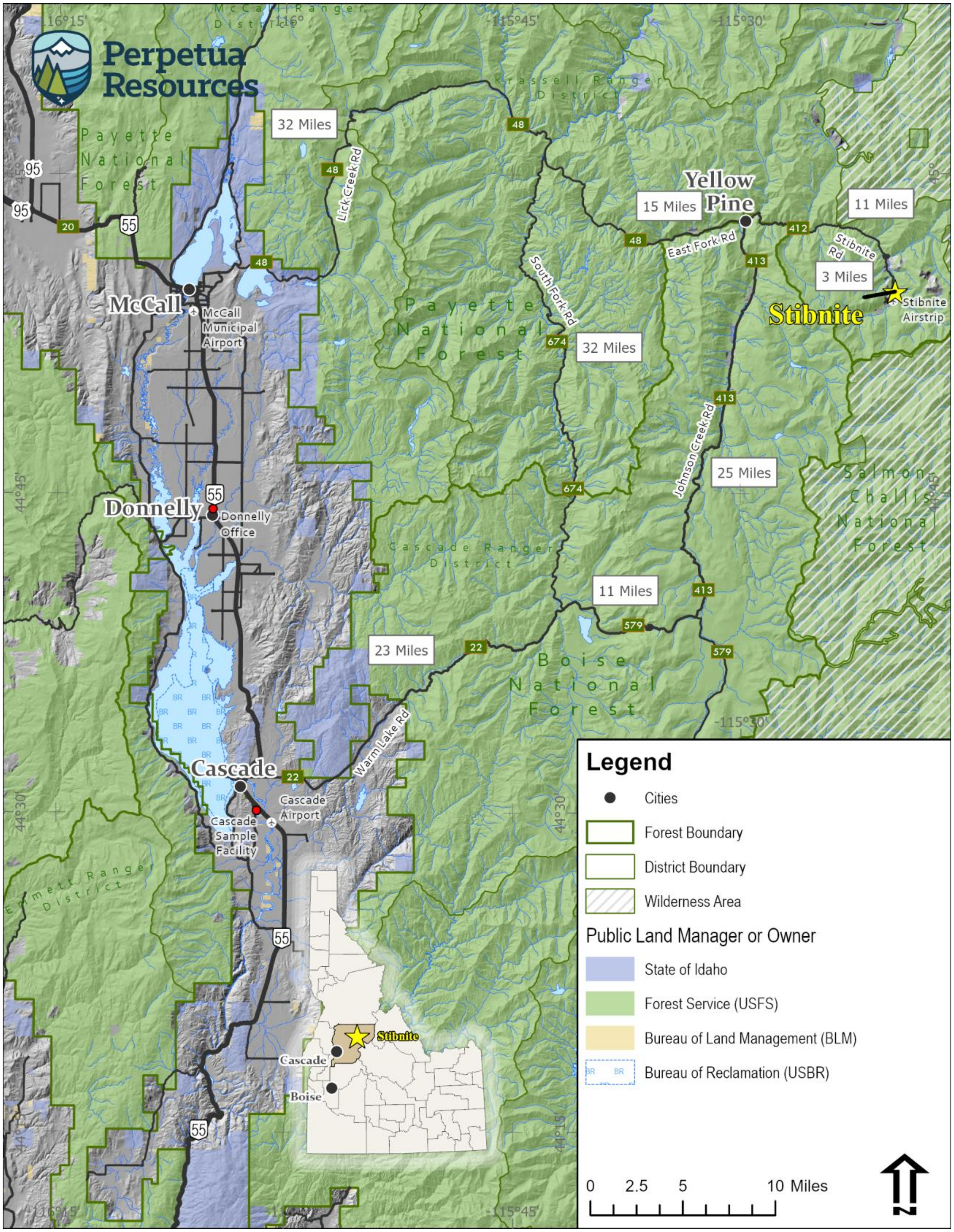

Figure 3-1 Site Location and Access

The Northwest Bradley dumps are located primarily on private lands owned by a U.S. subsidiary of Perpetua Resources Corp. Portions of the dumps and the proposed diversion route alternatives are located on public lands under the administrative authority of the Krassel Ranger District, Payette National Forest. Portions of the road that passes through this site are covered by an easement to Valley County. Access to this site is via the existing county road. Portions of the lower (northern) dumps are steep, potentially unstable and impinge upon the active EFSFSR channel and floodplain and access to these areas may require instream access or significant earthwork to facilitate safe use of excavators.

The DMEA dumps and adit site are located entirely on public lands under the administration of the Krassel Ranger District, Payette National Forest. Access to the dump and adit are via a gated, narrow unimproved spur road off the county road approximately 900 ft north of the dump and adit area. The road is listed as an unauthorized road by the Payette National Forest but has been in existence and in use since the 1940s by both private landowners and the Forest Service. The road is currently permitted administratively for limited use by Perpetua Resources, Idaho Inc. Existing access is sufficient for small to moderate size tracked equipment and for small dump trucks ($\leq$10 CY capacity) with only minor brushing and clearing of deadfall. Larger equipment would require tree cutting and possibly earthwork.

The surrounding area was heavily burned in 2007 wildfires and vegetation on the burned slopes is still poorly developed and there is high erosion potential if soils are disturbed during operations. A small perennial creek crossing is present along the spur of this road to the adit and dumps and would require armoring prior to any use. Several larger trees and a number of smaller lodgepoles would need to be cut to allow access for any equipment or vehicles along the spur. In addition, the slope below the road at this perennial creek crossing is unstable and will require reinforcement with ballast and riprap to allow for equipment and truck traffic to pass without causing a slope failure. Another access alternative to the use of this road and spur would be to access the dumps from below at the junction of a former reclaimed haul road and the county road where the unnamed stream passing through the dumps intersects the lower road reach.

The area around the former Smelter and Hecla heap leach pad is accessible via the existing county road. There are no barriers to access for heavy equipment unless activity involves work on the steep slopes above the valley floor.

3.4 OVERVIEW OF MINING HISTORY

There have been two major periods of exploration, development, and operations in the Stibnite-Yellow Pine Mining District (District) prior to Perpetua's involvement with the property, one spanning from the early 1900s through the 1950s and another during the period from the early 1970s through the mid-1990s. These activities that occurred over the past century have left behind substantial environmental impacts that remain to this day. The history of development and mining in the District is summarized in numerous publications including Larsen and Livingston (1920); Schrader and Ross (1926); White (1940); Cooper (1951); Hart (1979); Waite (1996); and Mitchell (2000) and various unpublished reports and documents prepared by Perpetua and others. Much of the information presented herein was obtained from these sources and unpublished Perpetua records.

The mining history of the region began in 1894 when the Caswell Brothers began a sluice box operation along Monumental Creek in what is now known as the Thunder Mountain Mining District, located east of Stibnite. By 1902, a gold rush was underway at that location, along with associated development of roads and creation of the town of Roosevelt. By 1909, the gold rush was essentially over; that spring, a mudslide blocked Monument Creek creating present-day Roosevelt Lake and submerging the town of Roosevelt. During the Thunder Mountain gold rush, many prospectors passed through the area now known as the Stibnite-Yellow Pine District, discovering mercury, antimony, silver, and gold. However, no development of any significance was completed until around 1917, when the World War I demand for mercury led to the development of several properties east of the main Project Area, including the Hermes group of claims located by Pringle Smith in 1902 and the Fern group located by E. H. VanMeter in 1917 (Larsen and Livingston, 1920; Schrader and Ross, 1926).

The first period of large-scale development commenced in the mid-1920s and continued into the 1950s, involving mining of gold, silver, antimony, and tungsten by both underground and, later, open pit mining methods. During World War II, the District is estimated to have produced more than 90% of the antimony and approximately 50% of the tungsten in the United States. These materials were used in making munitions, steel, fire retardants, and for other purposes. Mining of these strategic minerals was considered so critical that the Federal government subsidized the mining activity, managed site operations, and allowed military time for soldiers to be served at the mine site. Strategic metal mining operations within the District continued through much of the Korean War with antimony, gold, and tungsten mining and milling ceasing in 1952, near the end of that conflict.

The second period of major activity in the District started with exploration activities in 1974 and was followed by open pit mining and seasonal on-off heap leaching and one-time heap leaching from 1982 to 1997. Ore during this period was provided by multiple operators from several locations and processed in adjacent heap leaching facilities.

Between these periods of development, numerous prospects were discovered and explored using data and information obtained from soil and rock sampling, trenching, drilling, geophysical methods, and geologic mapping. Several of these prospects were developed into successful mining operations.

3.5 OVERVIEW OF LEGAL HISTORY

The Stibnite Mining District has been the subject of significant cost recovery litigation under CERCLA, and several consent decrees emerged from these actions.

In Mobil Oil versus United States, Civ. No. 99-1467-A (D. Virginia) (consent decree filed June 26, 2000); the United States ultimately released Mobil Oil Co. (successor to Superior Mining, a former mining operator in the Stibnite Mining District) from future CERCLA response costs and provided $1.55 million to Mobil as partial reimbursement for their response costs. In the settlement, the United States and Mobil Oil exchanged covenants not to sue, though the United States reserved rights as to natural resource damages as well as a future cause of action for up to $1.1 million for the costs of constructing an impermeable cap for the Spent Ore Disposal Area. The impermeable cap for SODA called for in the Mobil Oil settlement was never constructed.

In United States of America and State of Idaho versus State of J. J. Oberbillig, Case No. CV 02-451-S-LMB (D. Idaho) (consent decree filed March 18, 2004), EPA and USDA-FS resolved outstanding CERCLA litigation related to the PRP interest in both the Stibnite and Cinnabar Sites. Removal actions at Stibnite called for in the Oberbillig settlement included rerouting a stream around a tailings ore pile and other activities pursuant to AOCs with Stibnite Mining Inc. and Mobil Oil. In settling the litigation, the Oberbillig Estate paid EPA $116,503 in reimbursed past response costs, the USDA-FS Service $35,703, and the State of Idaho $35,703.

In United States versus Bradley Mining Company (BMC), Case No. 3:08-CV-03968 TEH and United States versus BMC, Case No. 3:08-CV-05501 TEH (N.D. Ca.) (consent decree filed April 19, 2012), covered several additional sites in addition to the Stibnite Project. The consent decree concluded two separately filed cases that were consolidated in the United States District Court for the Northern District of California. In exchange for a payment by the United States to EPA for $7.2 million, CERCLA covenants not to sue were extended to the USDA-FS, United States Department of Defense, United States Department of the Interior, EPA, and United States General Services Administration. It is believed that no CERCLA response actions have taken place in the Stibnite Mining District since the BMC case was settled in 2012.

This ASAOC became effective January 15, 2021. The ASAOC expressly found that current water quality monitoring data indicates the presence of elevated levels of aluminum, arsenic, antimony, cyanide, iron, manganese, mercury, and thallium within the Stibnite Mining District. EPA and USDA-FS determined that current Site conditions constitute an actual or threatened release of a hazardous substance, and thus the Phase I TCRAs set forth in the ASAOC are necessary to protect the public health, welfare, or the environment.

The ASAOC declares in paragraph 7 that even though “Phase 1 Work is expected to provide lasting environmental benefits, even if full-scale mining and restoration never occur,” the agreement will provide the option for “continued Work under this ASAOC during the [Perpetua] Respondents’ execution of the [Plan of Restoration and Operations] (as ultimately reviewed and if approved), while avoiding disruption to the execution of PRO actions,” see ASAOC paragraph 10. Accordingly, a longer-term response action strategy (through CERCLA non-time critical removal) is contemplated in subsequent Phases of the ASAOC if the Stibnite Gold Project becomes operational. “Returning a site of historic mining operations with legacy environmental issues to productive operations while addressing those legacy environmental issues has the potential to benefit the environment, economy, and local community.” See ASAOC paragraph 10.

4 SOURCES AND NATURE AND EXTENT OF CONTAMINATION

The following subsections describe previous mining and disposal practices in the TCRA area with discussion focused on the three areas at which surface water diversions are proposed, summarize monitoring results to define the extent of mining related impacts in the removal areas, describe prior reclamation efforts, and identify data needed to support the design of the selected design alternatives.

4.1 PREVIOUS MINING ACTIONS AND DISPOSAL PRACTICES

4.1.1 Project Area

The origins and transport of mine and mineral processing wastes within and near the Project Area have been evaluated by several investigators, most prominently by URS Corp (URS) (2000) and U.S. Geological Service (USGS) (2015). As described in Section 3.4, mining and ore processing that has occurred within and near the Project Area since the late 19th century has left a legacy of contamination within the surface water courses and, in some areas, shallow groundwater systems, derived from erosion and leaching of various sources of waste materials. The primary ore derived from these activities included stibnite (antimony sulfide), tungsten, gold, silver, and mercury. Trace elements associated with these materials and gangue are the primary contaminants of concern within the Site, as well as suspended and dissolved sediment transported through erosion and transport from disturbed areas, which are particularly prone to such processes.

Mining has been conducted using a variety of means since the late 19th century, ranging from removal of ore and waste rock using hand tools during the early days to operation of mechanized equipment (shovels, bulldozers, etc.) during more recent times to excavate and transport materials. Underground projects in the area were advanced using various explosives to loosen the rock to allow transport of the material (usually using ore cars on rail) to loadouts external to the underground workings, subsequently hauling ore to on-site locations where crushing and beneficiation occurred. Waste rock was typically disposed of in piles near the source of the mining activity, resulting in waste dumps, many of which are present today. Tailing materials derived from mineral processing activities were either stored in on-site impoundments or discharged to receiving streams where the material was either transported off-site or distributed along the floodplain in varying thicknesses. In some cases, the tailing impoundments breached, allowing the material to enter waterways and be transported downstream or be deposited along the floodplains.

4.1.2 Northwest Bradley Dumps

Material placed in the Northwest Bradley dumps is thought to consist of glacial till stripped off the Yellow Pine ore body, mineralized sulfide ore material containing gold but with stibnite (antimony ore) or scheelite (tungsten ore) grades insufficient to warrant processing by the BMC, and washed gravels from limited placer scheelite mining operations (unpublished BMC records). The ore grade materials are thought to consist of oxide materials which BMC was unable to process in its sulfide flotation plant, and gold-only mineralized sulfide altered materials that were wasted during antimony-tungsten mining operations. The materials that comprise the dumps likely were sourced from the Bradley pit (Figure 4-1).

Extensive development in the vicinity of the Northwest Bradley dumps (and broader Project Area) occurred during the World War II era, including construction of water diversions for Hennessy Creek to drive Pelton wheels and for water management, construction of crusher and haul truck load out facilities, as well as use of the area for waste rock disposal Historical photographs suggest the area was used for operation of a screen plant and gravity placer wash plant to recover scheelite from former mill tailings mixed with alluvium excavated from the EFSFSR below the Bradley pit in the 1950s (unpublished BMC records).

In the late 1980s, Hecla Mining Company (Hecla) utilized the dumps as a contractor staging area, for fuel storage sites, as a crusher generator site, and for part of the crusher conveyor and truck loadout system for Homestake pit mining operations. Records for this activity are limited with permitting through Idaho Department of Lands and associated state agencies (Unpublished records, variably dated, Idaho Department of Lands Payette Lakes District Office).

4.1.3 DMEA Waste Rock Dump

The earliest documented surface prospecting in the DMEA Adit and dump area occurred in the late 1920s or 1930s by Bradley interests (unpublished Oscar H. Hershey Geologic reports and letters to F.W. Bradley and P.R. Bradley and Yellow Pine Syndicate and Yellow Pine Company respectively, 1927-1935). Work during this period included surface prospecting and small-scale exploration; no significant surface or underground disturbance and no reported mining occurred in the adit area. When adjacent lands were patented in 1946, patent applications included unpatented lode mining claims in the DMEA portal area, but there was insufficient work and/or discovery documented to justify patenting (patent applications, Mineral Surveys, Mineral Surveyor Field Notes, and G.L.O. records, various dates).

The DMEA exploration adit was driven during the DMEA strategic minerals program, and the portal was collared in 1952. The DMEA program was established within the Department of the Interior, effective November 20, 1951, by the Secretary of the Interior when the previously established Defense Minerals Administration program was terminated. The DMEA Adit was driven, and associated dump created under a DMEA contract with 25 percent of the costs allocated to BMC and 75 percent to DMEA.

Development work in the DMEA workings included excavation of approximately 4,900 ft of cross cuts, drifts and several short raises, drilling of 27 underground holes totaling 13,488 ft, construction of a compressor station, mine dry and a dump. The adit was opened in 1952 and remained in use through 1955 or 1956. Anecdotal reports from local residents suggest the portal was open as late as the 1970s and aerial photographs from 1978 still show portions of the portal headframe, mine dry and other structures evident. It is unknown whether the portal had collapsed and/or been closed by this date. It is doubtful any type of formal closure occurred given the appearance of the portal and prevailing practices at the time of its abandonment. Based on historical maps and field observations, the portal was collared in bedrock, but is now collapsed and a small seep is present at the toe of the collapsed portal and dissipates into the dump.

4.1.4 Smelter Flats / Hangar Flats

The Smelter Flats / Hangar Flats area is the site of the former Meadow Creek Mine, mill, and smelter complex with early mining and beneficiation activities starting in the 1920s and extending through the 1950s. The Meadow Creek Mine was the largest producer of antimony in the United States for many of its operating years and for several years the largest lode gold mine in Idaho. The area included numerous old processing buildings, fuel storage, ponds, and tailings disposal facilities. During the late 1970s and early 1980s during construction of the on-off and after Hecla permanent heap leach pad, much of the former mill facilities were burned and buried nearby and larger scrap hauled off site or disposed of elsewhere in the area. There are no records available of these disposal activities.

In the 1980s, Hecla acquired interests to the property after a merger with Ranchers Exploration and Development Corporation who had an option from the underlying owners. The former smelter and mill burned, and some material was hauled off, but much of the former smelter and mill facility residues were buried to the south of the current heap leach pile. The site was later utilized as a heap leach pad and processing facility for Hecla's Homestake Mine located several miles to the north. Hecla's mining and processing operations ceased in the late 1990s and reclamation of the area continued until the mid-2000s.

4.2 EXTENT OF CONTAMINATION

Northwest Bradley Dumps

Figure 4-1 Northwest Bradly Dumps Site Features shows the current land cover (dumps being apparent with their weak vegetation), environmental sample locations, and other features associated with the Northwest Bradley dump TCRA site. Shallow hand dug surface samples collected on the Northwest Bradley dumps during the 1997-1998 Woodward-Clyde and URS site assessments (URS 2000) indicate dump materials exhibit elevated arsenic and antimony concentrations (above regional values) and, locally, mercury is present at relatively high concentrations, likely associated with prior mining activity. Samples collected from the site by Millennium Science and Engineering, Inc. (MSE) during 2010 also reported relatively high concentrations of these metals (MSE, 2011a).

Between 2012 and 2013, Midas Gold Idaho, Inc. (MGII) drilled and sampled several groundwater monitoring wells in the Northwest Bradley dumps area to characterize water quality (Brown and Caldwell, 2017). In 2015, MGII completed several auger holes to further characterize materials in the dumps after groundwater monitoring wells indicated elevated (with respect to drinking water standards) metals (primarily arsenic and antimony) in groundwater samples (Midas Gold Idaho Inc. [MGII], 2015).

Water quality samples are currently collected from locations in Hennessy Creek as part of Perpetua's continuing water quality monitoring program. Two sample locations of note (Figure 4-1) relative to the Northwest Bradley dumps are:

- YP-T-41: located in Hennessy Creek approximately 50 ft west of the county road, above the existing diversion ditch; and
- YP-T-48: located in the Hennessy Creek diversion on the north side of the county road, due north of the Northwest Bradley dump, below the culvert which conveys the creek beneath the county road toward the EFSFSR. YP-T-48 is downgradient of the point at which the creek infiltrates through the dumps and re-emerges as toe-seepage along the north side of the dump.

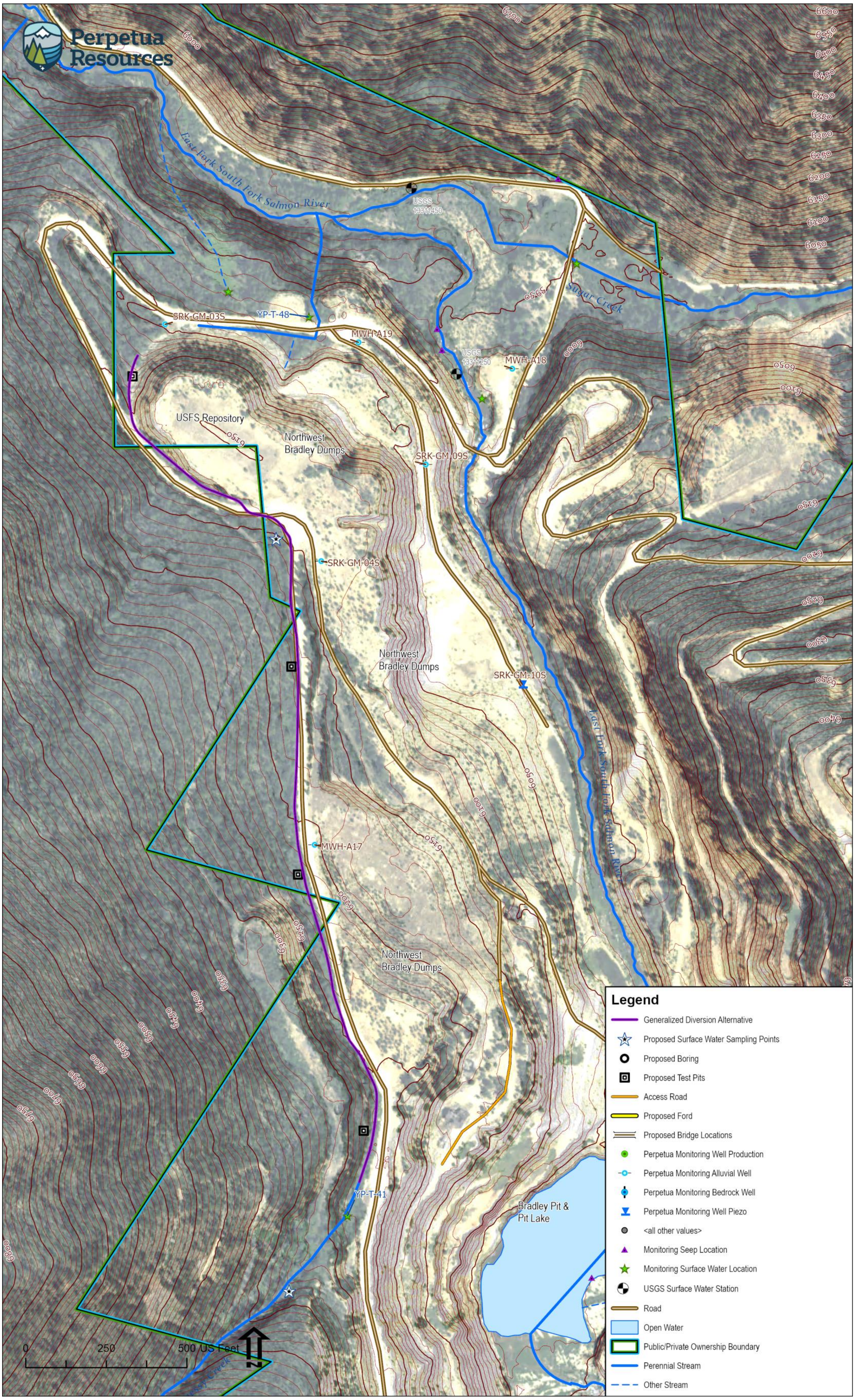

Figure 4-1 Northwest Bradly Dumps Site Features

Table 4-1 and Table 4-2 summarize flow and water quality statistics for pertinent sample sites from the 2018 Water Quality Summary Report (MGII, 2019).

Table 4-1 Surface Water Flow Statistics
Northwest Bradley Dumps Area

		Flow Statistics Cubic feet per second (cfs)			
Station	Name	Min	Max	Median	Mean
YP-T-41	Hennessy Creek	0.148	7.369	0.419	1.356
YP-T-48	Lower Hennessy Creek	0.093	5.091	0.325	1.029

Source: 2018 Water Quality Summary Report (WQSR).

Table 4-2 Water Quality Statistics for Key Constituents
Northwest Bradley Dumps Area

		Antimony (µg/L)				Arsenic (µg/L)				Mercury (ng/L)			
Station	WQ samples	Min	Max	Mean	Median	Min	Max	Mean	Median	Min	Max	Mean	Median
YP-T-41	90*	0.3	1.5	0.5	0.5	0.8	6.6	2.4	2.5	0.5	12.6	2.9	2.3
YP-T-48	52	12.2	71.9	27.5	27.3	7.76	107	27.1	19.45	1	64.3	4.3	2.5

Source: 2018 WQSR
*Hg analyses one less

The water quality sampling data statistics for Hennessy Creek indicate increases in antimony and arsenic concentrations measured below the Northwest Bradley dumps as compared to above the features. Flow measurements taken at monitoring locations YP-T-41 and YP-T-48, above and below the diversion ditch, indicate average infiltration losses of 24 percent, or total annual losses of approximately 385,000 cubic meters (312 acre-ft) based on monthly average flows. This infiltration rate is approximately four times the total volume of precipitation that falls on the dumps (based on a 32-in. annual total precipitation amount), not accounting for losses related to evapotranspiration. The losses from the current diversion could be a significant source of mine-impacted water reaching the EFSFSR through diffuse seepage pathways.

Water quality measured in Hennessy Creek at YP-T-41, upgradient of legacy mining disturbance, is believed to be representative of natural background water quality conditions for unmineralized areas in the Project Area. The Hennessy Creek watershed is located on the western side of the broad Meadow Creek Fault Zone (MCFZ). Drainages west of the MCFZ, including Hennessy, Fiddle, and upper Meadow Creek (Figure 2-7), are unmineralized to weakly mineralized, based on rock, soil, and stream sediment sampling populations. Rock, soil, and stream sediment samples collected from drainages on the west side of the MCFZ, such as Rabbit, Garnet, and Midnight creeks, commonly contain elevated concentrations of arsenic and antimony, and water quality in these drainages is likely representative of natural background conditions for mineralized areas.

Shallow groundwater underlying the Northwest Bradley dumps, adjacent to the EFSFSR, exhibits relatively high concentrations of dissolved arsenic and antimony. Dissolved arsenic concentrations measured in wells SRK-GM-09 and SRK-GM-10 (Figure 4-1) range from 279 to 1100 micrograms per liter (µg/L); substantially higher concentrations have been measured in well MWH-A19. Monitoring wells MWH-A17 and SRK-GM-04, located upgradient of the Northwest Bradley dumps exhibited relatively low arsenic concentrations (typically greater than 10 µg/L dissolved arsenic). Elevated concentrations of arsenic and antimony in groundwater in the vicinity of the Northwest Bradley dumps are attributed to oxidation of sulfide-bearing mineralized rock in the dumps, as sampled in drilling programs

(MGI, 2015). Infiltration of Hennessy Creek through the dumps may contribute to inflows of impacted groundwater into the EFSFSR.

4.2.1.1 *Previous Removal and Cleanup Actions*

In 2002 and 2003, MSE, under contract with the Forest Service and EPA, constructed an unlined waste repository in the vicinity of the Northwest Bradley dumps to store residual soils contaminated with high levels of arsenic. These materials were obtained from the former smelter and tailings area along Meadow Creek from various “poison ponds,” recovered in two removal actions (MSE, 2003a).

4.2.1.2 *Data Gaps Discussion*

Based on analysis of the existing data and information available for Hennessy Creek, the Northwest Bradley Waste Rock Dumps, and the existing diversion structures as well as the needs of the engineering team in preparing designs for the new diversions systems, Perpetua identified the following gaps in data and information:

- Hennessy Creek infiltration volumes and flow pathways through the Northwest Bradley dumps are poorly understood.
- Leakage from the existing Hennessy Creek diversion ditch and the potential pathways of water movement associated with legacy infrastructure (e.g., plumbing that once served Pelton wheels in structures in the Bradley pit) are poorly understood.
- Integrity of existing culverts.
- Details of topography not reflected in LiDAR surveys.

4.2.2 DMEA Waste Rock Dump

The DMEA Adit and Waste Rock Dump were the result of underground tungsten and antimony exploration, and development work associated with the Defense Minerals Administration program in the Stibnite area, which was conducted under the 1950 Defense Production Act to explore for critical and strategic minerals. The DMEA dump covers approximately 0.75 acres and is estimated to contain approximately 10,000 CY of sulfidic-altered waste rock mined from the DMEA exploration drift.

Constituent loading of the unnamed drainage in the DMEA area is attributed to both adit seepage and the stream impinging on the dump (MSE, 2011b and URS, 2000). The stream currently flows northeast along the base of the DMEA dump for approximately 320 ft. The stream course was pushed southwest from its original channel during dump construction and much of the water is believed to flow through the dump toe in the lower 150 ft of the channel, as evidenced by reduced streamflow and presence of numerous seeps. Seepage from the DMEA Adit appears to infiltrate into the dump within 20 ft of the portal. There is potential that additional water emanates from the adit in the subsurface, but this is likely to be a low discharge as bedrock is present at a shallow depth as indicated by exposed ore-cart rails. Below the dump, the stream and toe seeps flow downslope approximately 150 ft through multiple small channels and along the roadway to a sedimentation pond and ultimately into the EFSFSR.

Water quality samples are collected regularly from two locations in the removal area as part of Perpetua’s baseline water quality monitoring program (Figure 4-2). Samples collected from monitoring location YP-AS-6 represent adit seepage at the collapsed adit portal, and monitoring location YP-T-17 is located in an area of toe seepage from the base of the dump. Sampling flow and water quality statistical summaries for sampling, completed at these locations are provided in Table 4-3 and Table 4-4, respectively. Additional locations in the vicinity of the DMEA Waste Rock Dump were sampled in May 2009 for a Phase II Environmental Assessment (MSE 2011b). YP-T-19 is approximately

550 ft upgradient of the DMEA dump and adit, and YP-T-18 is located in the ditch along the roadway below the area of toe seepage (Figure 4-2). Table 4-5 summarizes flow and water quality data collected at these sites.

Table 4-3. Surface Water Flow Statistics: DMEA Waste Rock Dump Area

		Flow statistics (cfs)			
Station	Name	Min	Max	Median	Mean
YP-T-17	DMEA Waste Rock Seep	0	0.117	0.007	0.016
YP-AS-6	DMEA Adit Seep	0	0.021	0.004	0.006

Source: _2018 WQSR

Table 4-4. Water Quality Statistics for Key Constituents: DMEA Waste Rock Dump Area

		Antimony ug/L				Arsenic ug/L				Mercury ng/L			
Station	WQ samples*	Min	Max	Mean	Median	Min	Max	Mean	Median	Min	Max	Mean	Median
YP-AS-6	48	14	27	22.2	23.3	192	326	240.6	229.5	0.6	34.8	2.8	1.4
YP-T-17	50	11	164	30.6	27.9	44.4	18800	744.3	210	0.8	632	47.3	3.3

Source: _ Source: _2018 WQSR
*Hg analyses one less

Table 4-5. Surface Water Flow and Quality Measurements for May 2009 MSE Samples: DMEA

MSE Phase II ESA May 29, 2009		Flow cfs	Antimony ug/L (D)	Arsenic ug/L (D)	Mercury ng/L (D)
YP-T-19	Stream above workings	0.707	12.2	156	<0.2
YP-T-18	Stream along road	0.316	48.3	174	<0.2

Source: MSE (2011)

Seepage flow measurements for YP-T-17, measured at the toe of the waste rock dump, do not account for the full flow in the stream, which flows overland in a broad area below the dump. Flow measured at YP-T-18 and YP-T-19, more accurately account for the discharge of the perennial stream. Concentrations measured at YP-T-19 provide an estimate of natural background water quality in the drainage. Elevated concentrations of arsenic and antimony upgradient of the mining disturbances are consistent with presence of widespread mineralization in this area east of the MCFZ, as targeted in the underground DMEA exploration adit, and indicated by elevated concentrations of arsenic and antimony in rock and soil samples from this area. Sample results for the downgradient monitoring point, YP-T-18, show modest increases in key constituents attributed to interaction of upgradient surface water with mine wastes and adit seepage.

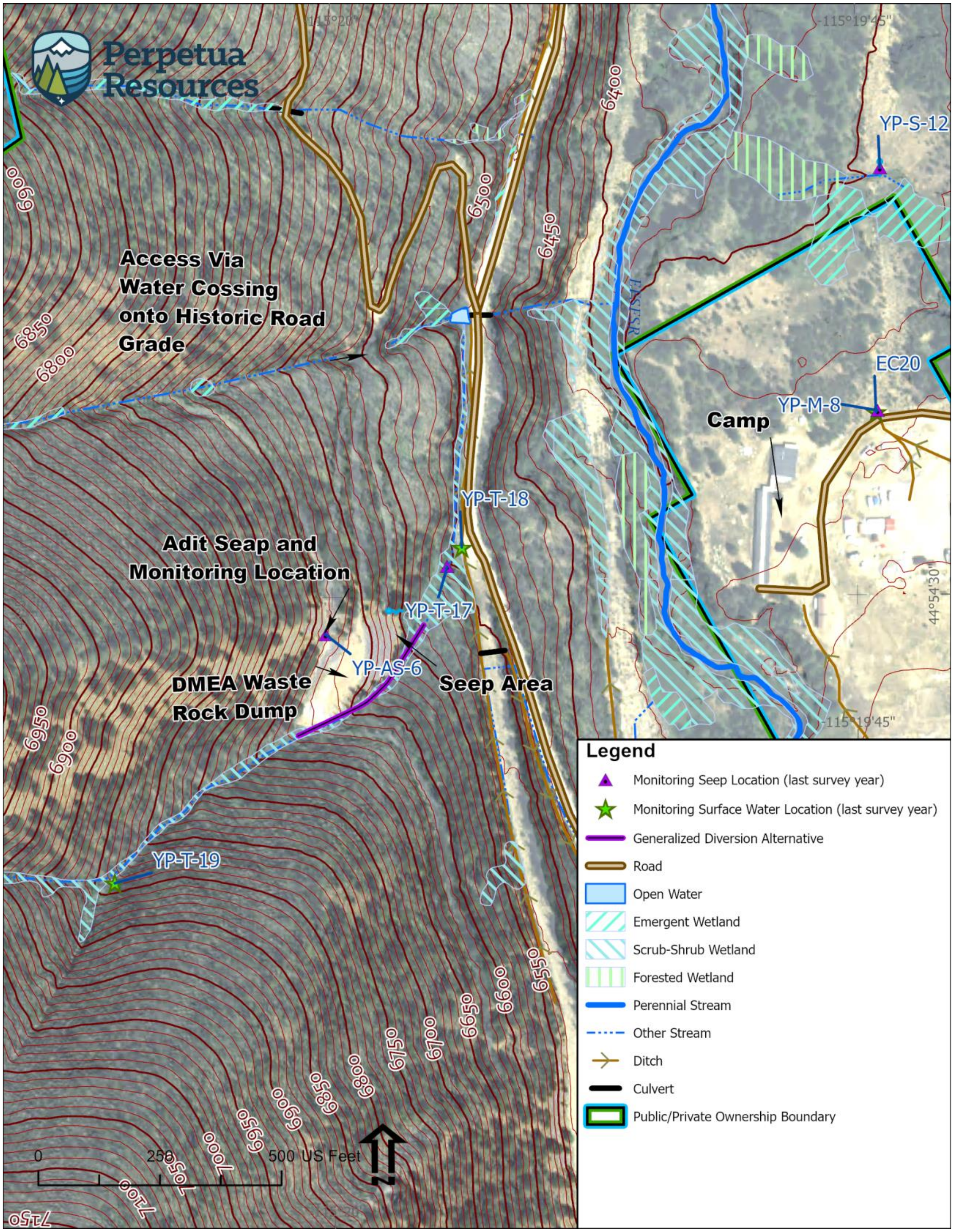

Figure 4-2 DMEA Waste Rock Dump Site Features

4.2.2.1 *Previous Removal and Cleanup Actions*

No previous removal or cleanup actions are known to have been conducted at the DMEA Waste Rock Dump or Adit, other than decommissioning of the underground mining support infrastructure at the cessation of exploration activities in the mid-1950s.

4.2.2.2 *Data Gaps Discussion*

Based on our analysis of the existing data and information available for the DMEA Waste Rock Dump site and the needs of the engineering team in preparing designs for a diversion or source removal TCRA, Perpetua identified the following gaps in data and information:

- Background water quality upstream and north of the DMEA dump.
- Uncertainty of geochemical and engineering properties of waste rock material associated with the DMEA dump.
- Geotechnical stability of potential construction access.
- Details of topography not reflected in LiDAR surveys.

4.2.3 Smelter Flats / Hangar Flats

The Bradley Mill and Smelter Area and Hangar Flats (aka "Smelter Flats") is the site of former legacy mineral processing activities in the Meadow Creek valley, approximately 0.75 miles southwest of the confluence of Meadow Creek with EFSFSR, adjacent to the Hecla heap leach pad (Figure 4-3). Materials associated with the former Meadow Creek Mill, which was burned, bulldozed, and subsequently buried, are present over approximately 5 acres of hillslope directly west of the Hecla heap leach pad. Remnants of the former smelter complex and processing ponds cover an 8-acre flat area, southwest of the Hecla heap leach pad; this area is locally known as "Smelter Flats".

Figure 4-4 is a photograph of the area from the 1940s showing many of these features.

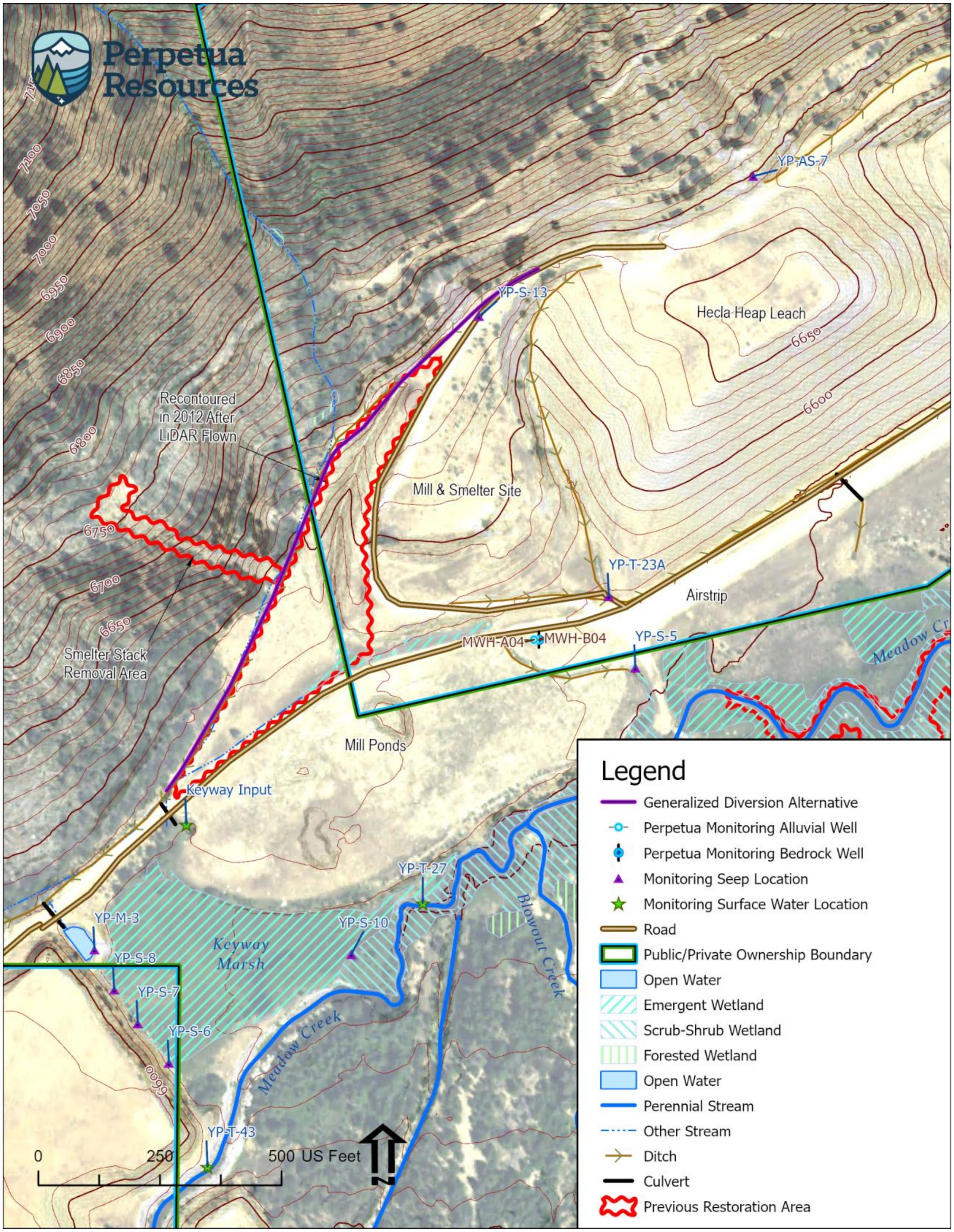

Figure 4-3 Smelter Flats/Hanger Flats Site Features

Figure 4-4 Meadow Creek Mill, Airstrip, Process Ponds and Smelter Construction Site, 1940s.

Seepage of upgradient surface water and shallow groundwater through buried mill and smelter materials in the former mill site area are thought to mobilize metals from the waste materials into downgradient surface water and groundwater. Water quality samples are regularly collected by Perpetua from two locations (YP-S-5 and YP-T-23) in the TCRA area as part of Perpetua's ongoing water quality monitoring program (Figure 4-3). Location YP-S-5 is a seep that emanates from the base of the buried mill site, with water diverted beneath the road to a location at the southern end of the airstrip. Sampling location YP-T-23A is seepage that is present between the mill site and Hecla heap leach pad. Sample location YP-T-23 is in a minor tributary, located upgradient of the mill site debris; this site was sampled once for the MSE Phase II Environmental Assessment (MSE 2011c). Statistical summaries of measured flow and water quality characteristics for key constituents are included in Tables 4-3 through 4-5.

Table 4-3 Summary of Surface Water Flow Statistics: Smelter Flats / Hangar Flats Area

		Flow Statistics (cfs)			
Station	Name	Min	Max	Median	Mean
YP-T-23A	Heap Leach Seep	0	0.134	0.016	0.03
YP-S-5	Smelter Flats Seep	0.001	0.191	0.013	0.029

Source: 2018 WQSR

Table 4-4 Water Quality Statistics for Key Constituents: Smelter Flats / Hangar Flats Area

		Antimony ug/L				Arsenic µg/L				Mercury ng/L			
Station	WQ samples*	Min	Max	Mean	Median	Min	Max	Mean	Median	Min	Max	Mean	Median
YP-T-23A	50	33	4940	1648	1115	324	5130	1221.3	859.5	1.6	405	42.0	8.3
YP-S-5	16	37.9	5140	2345	2275	817	5540	1508.6	1120	12.7	11700	839.9	45.15

Source: 2018 WQSR, * Hg on sample less

Table 4-5 Water Quality Statistics for Key Constituents: Smelter Flats / Hangar Flats Area (MSE, 2011a)

		Flow cfs	Antimony µg/L (d)	Arsenic µg/L (d)	Mercury ng/L (d)
YP-T-23	Stream above leach pad	0.47	7.42	<3.0	<0.2
YP-T-23A	Heap Leach Seep	0.297	1660	203	<0.2

Source: MSE (2011a)

Water quality measured in the unnamed tributary at YP-T-23, upgradient of legacy mining disturbance, may be representative of natural background water quality conditions for unmineralized areas, although it is possible water at this location may be impacted by legacy mineral processing activities. Arsenic concentrations at YP-T-23 are consistent with surface water quality measured in samples obtained from unmineralized watersheds west of the MCFZ, including Hennessy, Fiddle, and upper Meadow creeks. The slightly elevated antimony concentration measured in the sample may reflect impacts associated with antimony smelting historically conducted in the area.

Samples obtained from seeps at YP-T-23A and YP-S-**5** (Figure 4-3) exhibit elevated antimony, arsenic, and mercury compared to background (assumed represented by sample site YP-T-23), which may be attributed to the interaction of water with buried mining wastes and mill site debris. Water quality in alluvial monitoring well MWH-A04 (

Figure 4-3), at the base of the mill site, is similarly impacted, giving greater credence to the conceptual model of contaminant movement in the area. Diverting the surface water entering the Smelter Flats area would presumably eliminate this source of recharge and improve the receiving streams; Meadow Creek and the EFSFSR. Groundwater monitoring wells screened in bedrock here likewise show highly elevated arsenic and antimony values attributed to either anthropogenic contamination or naturally high metal contents due the presence of mineralization associated with the Hangar Flats deposit which underlies portions of the former mill and smelter site.

4.2.3.1 *Previous Removal and Cleanup Actions*

In 2002 and 2003, MSE, under contract with the Forest Service and EPA, excavated residual soils contaminated with high levels of arsenic from the former smelter and tailings from various "poison ponds." These materials were recovered in two removal actions conducted near the former mill and smelter site (MSE, 2003b). In 2009 and 2010, the area was regraded and backfilled and a large diversion ditch designed to capture and divert surface water from two perennial streams, and several seeps at the toe of the slope (Idaho Department of Environmental Quality [IDEQ], 2005) was removed by contractors at the direction of the Forest Service. The seeps at the base of the hill, that had been the reason for the diversion ditch installation, increased flow shortly thereafter, suggesting that the diversion water previously directed into the surface ditch was now percolating into the subsurface and likely encountering and mobilizing metal from the buried mill and smelter materials beneath the fill.

Upon closure of the heap leach facility, Hecla rinsed the heaps and added cyanide destructive bacteria and installed a treatment system to address discharge waters exhibiting high arsenic concentrations. The treatment system consisted of a shallow land application system in a series of zero-valent iron tanks near the north end of the existing airstrip. The State of Idaho approved the Permanent Closure Report and released the reclamation bond in January 2005 (Hardesty, 2005).

4.2.3.2 *Data Gaps Discussion*

Based on our analysis of the existing data and information available for the Smelter Flats / Hangar Flats TCRA site and the needs of the engineering team in preparing a diversion design package, Perpetua identified the following gaps in data and information:

- Gradation and type of material likely to be encountered in construction of the diversion, including potential presence of contaminated soils particularly in the vicinity of the former smelter stack.
- Integrity of existing culverts.
- Details of topography not reflected in LiDAR surveys.
- Background water quality in unaffected drainages.

5 FIELD SAMPLING AND DATA NEEDS

To address the various data gaps for the three diversion project areas as described in Section 4, Perpetua prepared a separate field sampling plan to guide efforts to address the data and information deficiencies. Field investigations to assess suitability of on-site material for stream diversions including liner bedding, fill materials and riprap are discussed in the Borrow Source Development Plan (Appendix B). Details on how specific field investigations will be completed are presented in the Field Sampling Plan and Quality Assurance Project Plan (QAPP) (separate document). A summary of field objectives is presented below.

5.1 HENNESSY CREEK AT NORTHWEST BRADLEY DUMPS

5.1.1 Goals and Objectives

The primary objective of the field investigation is to collect data necessary to design an improved Hennessy Creek diversion. Specific objectives include:

- Investigate the existing diversion to determine where leakage occurs, which sections require lining, and what materials would be encountered in excavation for the ditch upgrades.
- Determine the sizing and integrity of existing culverts.
- Understand potential pathways associated with legacy infrastructure (e.g., plumbing that once served Pelton wheels in structures in the Bradley pit) to inform design.
- Establish background surface water quality in drainage upstream of the diversion.

5.2 DMEA WASTE ROCK DUMP

5.2.1 Goals and Objectives

The primary objectives of the field investigation associated with the DMEA Waste Rock Dump include:

- Determine vertical extent of waste rock.
- Determine physical, geotechnical, and chemical characteristics of waste rock.
- Characterize surface water quality and flow upstream and adjacent to the DMEA waste rock dump.
- Conduct topographic survey of channel alignment and existing topography.

5.3 SMELTER FLATS / HANGAR FLATS

5.3.1 Goals and Objectives

The primary objective of the Smelter Flats / Hangar Flats field investigation is to collect physical and chemical data on subsurface material along the proposed diversion, including the presence of mining related impacts in the vicinity of the former smelter stack. Additional study objectives are as follows:

- Characterize subsurface conditions along the diversion alignment (physical characteristics and presence/absence of mining-related impacts);
- Obtain background surface water quality upstream of the Smelter Flats/Hangar Flats stream diversion; and
- Inspect the integrity of the existing culvert network, note culvert diameters, and survey culvert pipe invert elevation.

6 ARARS IDENTIFICATION AND DISCUSSION

ARARs for the TCRA are defined in the Action Memorandum (EPA, 2021). Additional guidance and regulatory requirements will be identified in the design packages.

7 SELECTED DESIGN ALTERNATIVES

This section presents a detailed evaluation of the design alternatives developed and selected for this TCRA. Removal action design alternatives are evaluated against short- and long-term aspects of effectiveness and implementability (EPA, 1991). A general description of each criterion is provided below. Cost estimates for the selected alternatives are presented below but were not a selection criterion for the TCRA design alternatives.

7.1 NORTHWEST BRADLEY WASTE DUMPS DIVERSION

The selected design alternative for Northwest Bradley Waste Dumps Diversion is H-1.

7.1.1 Effectiveness

Design alternative H-1 provides the highest level of effectiveness in isolating the relatively unimpacted water in upper Hennessy Creek drainage from contacting mine waste materials in the Northwest Bradley dumps. The selected design alternative would reduce the likelihood of fish/wildlife exposure to deleterious water quality and provide for a net benefit in improving the receiving water quality in the EFSFSR. Even so, potentially applicable water quality standards will likely not be met within the diversion or within the EFSFSR. It is likely that upgradient (relatively unimpacted) water quality would be maintained within the channel constructed under the selected design alternative.

The long-term effectiveness and permanence aspects of the selected design alternative is related to the degree of maintenance that would be required to keep the system functional. In this regard, Design alternative H-1 is the most effective, primarily because maintenance of the diversion would be easier and the system relatively straight-forward to design, construct, and operate.

The selected design alternative would not result in reduction of toxicity, mobility, or volume of contaminants through treatment, as it does not incorporate such technologies. The selected design alternative, however, does isolate relatively high-quality water from deterioration and would result in a net improvement in the quality of the receiving water through metals load reductions attributed to seepage of Hennessy Creek through the Northwest Bradley dumps. Design Alternative H-1 would intercept surface runoff from the unnamed watershed north of Hennessy Creek upgradient of the Northwest Bradley Dumps, which provides the greatest separation of diversion intake from mine wastes. The selected design alternative could be effective in improving water quality in the EFSFSR following drain down of the dumps once surface water inflows are reduced, but the timeframe for this is dependent on hydrologic properties and flow paths through the dumps, which are uncertain. Whether surface water in the EFSFSR would show measurable improvements from the diversion is also uncertain.

7.1.1.1 *Overall protection of human health and the environment*

There is no risk to human health. Reducing the metals loads to the EFSFSR from the Northwest Bradley Dumps source will improve receiving water quality, which would decrease environmental risks.

7.1.1.2 *Compliance with ARARs*

Chemical-specific ARARs for surface water quality at the outlet of the diversion would potentially be met by this design alternative. Location-specific ARARs related to construction activity and stream diversion in floodplains or wetlands would be met. Action-specific ARARs for stream channel alteration would be met. Species listed under the Endangered Species Act (ESA) are not known in Hennessy Creek or the removal area (no fish are known to exist in Hennessy Creek) but are present in the receiving EFSFSR. Best management practices (BMPs) would be used to manage storm water runoff and sediment during construction and for control of fugitive dust emissions.

7.1.1.3 *Long-term effectiveness and permanence*

The lined diversion would be effective at reducing infiltration of surface water through the dumps, which is believed to be a primary source of leaching and migration of metals and subsequent release to surface water, thereby reducing residual risk. Installation of a lined channel would be an adequate and reliable diversion system that would be viable over the long term. The RAO to design removal actions that provide for long-term physical stability and have low maintenance requirements would be achieved.

7.1.1.4 *Reduction of toxicity, mobility, or volume through treatment*

No treatment would be implemented under this design alternative.

7.1.1.5 *Short-term effectiveness*

There would be no risks to nearby communities during implementation of the removal actions. Risks to construction workers from mine waste material, if any, encountered during construction activities would be mitigated using standard health and safety protocols. Short-term environmental impacts related to construction such as dust generation and storm water runoff would be mitigated using standard BMPs. Perpetua has prepared an Environmental Protection Plan (EPP) that outlines the various measures to be taken to protect fisheries, aquatic life, and stream water quality during construction of the TCRAs. The RAO to reduce contact of surface water with mine waste would be achieved immediately upon completion of construction. The RAO to reduce sources of metals to local surface water and groundwater may be realized following drain down of the dumps once surface water inflows are reduced.

7.1.2 Implementability

Design Alternative H-1 provides the highest level of performance against the implementability criterion. Conventional equipment and construction personnel with standard skillsets would be able to construct Design Alternative H-1. Some expertise and specialty equipment may be required for liner installation, depending on the liner ultimately selected. The selected design alternative would require off-site power or infrastructure beyond access road improvements and, in some cases, installation of temporary stream diversions. Culvert replacements may be required under the selected design alternative.

Access and maintenance for Design Alternative H-1 is simplified by the diversion being located almost entirely adjacent to the existing county road.

Construction of the lined ditch should not begin until the season when lowest flow conditions are typically found, and temporary piping in diversions will be required for sections requiring lining. Traffic management will be required on the public road during construction.

Consultations with State of Idaho and possibly Federal government regulators may be required for the selected design alternative. Substantive requirements of permits will be met, although the need to secure the actual permits under CERCLA is unlikely. Design Alternative H-1 would not result in impacts to wetlands areas near the outfall of Hennessy Creek into the EFSFSR, reducing the length and complexity of consultation.

7.1.2.1 *Technical Feasibility*

Lined channels are easily constructed using standard earth-moving equipment (backhoes, dozers, loaders, trucks), however, the length of this channel segment and limited construction period due to water management requirements may require multiple construction seasons for completion. Construction personnel will have standard skills with specialized labor required to install and test the geosynthetic liner. Materials and supplies needed are readily available, pending supply chain issues associated with COVID-19-related disruptions.

7.1.2.2 *Infrastructure Requirements*

Off-site power will not be required to support construction of this design alternative. Access roads to allow improvements to the existing diversion may need improvement to allow heavy equipment to reach portions of the channel.

7.1.2.3 *Reliability and Complexity of Operation*

The design of this alternative is relatively simple and has been constructed at numerous locations around the world. Operation will be generally passive and simple with periodic maintenance required to maintain the functionality of the diversion.

7.1.2.4 *Accessibility*

Construction will necessarily need to be completed during the late summer and fall months owing to snow and high water in the existing diversion channel preventing access otherwise. Access to the existing diversion structure to allow upgrades will require improvements to access roads. Construction may require limited modifications or temporary closure of the existing county road adjacent to the diversion.

7.1.2.5 *Administrative Feasibility*

From an administrative standpoint, this design alternative would be relatively straight-forward to construct. Consultations with appropriate State of Idaho and Federal agencies related to performing a construction project and for approval of the EPP, would be required. No offsite treatment, storage, or disposal services would be required. The technologies, equipment, and specialists (e.g., installation of geosynthetic liners) needed to complete the project are readily available.

7.1.3 Cost

The estimated cost to upgrade approximately 2,900 ft of the existing diversion channel is $686,000 (Table 7-1). This will require approximately 6 weeks to complete based on a 7 day per week, day-shift-only work schedule, but this estimate does not account for delays associated with water management activities for the active channel, and assumes concurrent phasing of activities, which may not occur. The cost estimate was developed using first principles based on equipment and labor rates published in the USDA-FS Cost Estimating Guide for Road Construction (USDA-FS, 2020) and vendor quotes for consumables. Contingencies considered EPA guidance (USACE and EPA, 2000), modified as appropriate to account for site-specific conditions.

Table 7-1 Design Alternative H-1 Cost Estimate

Cost Item / Footnote	Description	Quantity	Units	Duration (days)	Unit Cost	Cost ($)
1	Salvage organic materials, establish erosion controls, and manage water	2,900	ft	3	$24.30	$70,483
2	Excavate to subgrade and prep for geomembrane	3,136	yd^3	9	$16.54	$51,856
3	Load, haul, place backfill for geomembrane	642	yd^3	4	$36.81	$23,631
4	Line channel with geomembrane	4,253	yd^2	7	$10.57	$44,948
5	Load, haul, place base fill on geomembrane	475	yd^3	3	$36.81	$17,484
6	Screen, load, haul, place riprap on base fill	1,425	yd^3	14	$73.48	$104,706
7	Revegetate along new channel wherever construction disturbance occurred	0.67	acre	1	$5,410	$3,601
					Equipment, Labor, & Supplies	**$316,710**
					Mobilization / Demobilization (8.0%)	$25,337
					Remote Site Room & Board	$74,000
					Engineering (10.0%)	$31,671
					Overhead (15.0%)	$47,507
					Construction Monitoring (5.0%)	$15,836
					Annual Post Construction Maintenance (2.5%)	$7,918
					Annual Maintenance NPV (5 years)	$37,759
					Subtotal	**$548,819**
					Contingency (25.0%)	$137,205
					Total Estimated Cost	**$686,024**

Footnotes

Note: All equipment listed below includes operator cost.

1 - Cost based on using a 4-yd^3 excavator, a 215-HP dozer, a 14-ft blade grader, two laborers, a survey crew (50%), 500-ft 6-in. polypipe, water diversion structure, and erosion controls for the entire length of channel.

2 - Cost based on using a 3-yd^3 excavator, a 40-ton truck, a 48-HP skid steer, two laborers, and partial survey crew.

3 - Cost based on using a 40-ton truck, 99-HP backhoe, a 48-HP skid steer, two laborers, a 110-HP screen plant assuming 50% reject supported with a 5-yd^3 loader, and 350-HP dozer with ripper attachment.

4 - Cost based on using a 99-HP backhoe, a 48-HP skid steer, three laborers, and 60-mill DST geomembrane.

5 - Cost based on using a 40-ton truck, a 99-HP backhoe, a 48-HP skid steer, two laborers, a 110-HP screen plant assuming 50% reject supported with a 5-yd^3 loader and 350-HP dozer with ripper attachment.

6 - Cost based on using a 5-yd^3 loader, a 40-ton truck, a 99-HP backhoe, a 48-HP skid steer, two laborers, a 110-HP screen plant with rock crusher assuming 60% reject supported with a 5-yd^3 loader and 350-HP dozer with ripper attachment.

7 - Cost based on using a 115-HP mulcher, 48-HP skid steer, two laborers, upland seed mix, fertilizer, and 321 plants per acre.

7.2 DMEA WASTE DUMP DIVERSION

The selected design alternative for the DMEA Waste Dumps Diversion us D-2 .

7.2.1 Effectiveness

The selected design alternative would be effective in terms of the primary project objective (i.e., isolating the relatively unimpacted water in the unnamed drainage above the DMEA dump from impacts associated with seepage through the mine waste materials). Existing water quality data above and below the dump is insufficient to determine if the stream is significantly impacted by the dump, or if concentrations reflect natural background conditions, and therefore precludes reasonable projection of potential improvements to surface water quality associated with the design alternative. The selected alternative would theoretically decrease environmental risks to aquatic species by reducing contact of unimpacted surface water with mine waste materials and provide for a net benefit in improving the receiving water quality in the EFSFSR.

For the selected design alternative, potentially applicable water quality standards will likely not be met at either the outlet of the diversion, or in the EFSFSR downstream under any option due the presence of other sources upgradient of the DMEA dump.

The long-term effectiveness and permanence considerations favor removal of the DMEA waste dump. Removal of the source and reclaiming the original channel and disturbed areas would not require maintenance and, once stabilized, would result in a permanent mitigation.

7.2.1.1 *Overall protection of human health and the environment*

There is no risk to human health. Reducing the metals loads to the ephemeral stream from the DMEA dump will improve receiving water quality, which would decrease environmental risks. However, environmental risks would remain related to precipitation on the remaining portions of DMEA dump and discharges from the DMEA adit.

7.2.1.2 *Compliance with ARARs*

Chemical-specific ARARs for surface water quality at the outlet of this diversion would not be met by this design alternative due to existing up-gradient water quality exceedances. Location-specific ARARs related to construction activity in wetlands would be met. Action-specific ARARs for stream channel alteration and control of fugitive dust would be met. ESA listed species are not known in DMEA Creek or the removal area but are present in the receiving EFSFSR. BMPs would be used to manage storm water runoff and sediment during construction.

7.2.1.3 *Long-term effectiveness and permanence*

Removal of mine waste in the DMEA dump would reduce leaching and migration of metals and subsequent release to surface water, thereby reducing residual risk in the removal action area, but risks may be increased in the waste destination area. Residual risks would remain from DMEA adit discharges. Removal and disposal would be an adequate and reliable design alternative that would be viable over the long term. The RAO to design removal actions that provide for long-term physical stability and have low maintenance requirements would be achieved.

7.2.1.4 *Reduction of toxicity, mobility, or volume through treatment*

No treatment would be implemented under this design alternative.

7.2.1.5 *Short-term effectiveness*

There would be no risks to nearby communities during implementation of the removal actions. Risks to construction workers from mine waste material during construction activities would be mitigated using standard health and safety protocols. Short-term environmental impacts related to construction such as dust generation and storm water runoff would be mitigated using standard BMPs. Perpetua has prepared an EPP that outlines the various measures to be taken to protect fisheries, aquatic life, and stream water quality during construction of the TCRAs. The RAO to reduce contact of surface water with mine waste would be achieved immediately upon completion of construction. The RAO to reduce sources of metals to local surface water and groundwater would also be met immediately, with continued decreases over the first few years as the effects move downgradient and as the physical stability of the disturbed areas is enhanced through reclamation and stream channel reconstruction/restoration, however, water quality effects are anticipated to be minor and may not be measurable in receiving waters.

7.2.2 Implementability

Conventional equipment and construction personnel with standard skillsets would be able to construct the selected design alternative. The selected design alternative would be relatively easy to design and construct as technologies used under are routinely applied nationwide. However, Design Alternative D-2 will have additional complexity due to the steep terrain, narrow access roads and dump face at the angle of repose, as well as the need to establish and meet performance objectives for the removal activity. Additionally, the natural channel reconstruction component increases overall project complexity of Design Alternative D-2.

Permits would not be required for either action, but consultations with State of Idaho and additional federal agencies on the EPP are likely to be similar for all design alternatives. Design Alternative D-2 would essentially be self-mitigating with respect to wetland impacts or may potentially constitute a credit that can offset impacts created by other CERCLA projects conducted under the ASAOC.

7.2.2.1 *Technical Feasibility*

Standard earth-moving equipment (excavators, dozers, trucks) will be used to construct this design alternative. Construction personnel will need to have standard skills to accomplish the dump removal. Stability monitoring during equipment operation on and under the dump may be required. Specialized labor may be required to reconstruct the stream channel through the area, particularly that component associated with revegetation. It is anticipated this design alternative can be constructed and made operational within one construction season, although follow-on maintenance of the revegetation associated with site reclamation may be required for one or two additional growing seasons. Materials and supplies needed are readily available, pending supply chain issues associated with COVID-19-related disruptions.

7.2.2.2 *Infrastructure Requirements*

Off-site power will not be required to support construction of this design alternative. Access road improvement to the DMEA dump will be required to allow entry of haul trucks and allow transport of the material to the Northwest Bradley dumps. Appropriate BMPs will need to be developed and implemented to reduce construction-related environmental impacts (e.g., erosion, sedimentation).

7.2.2.3 *Reliability and Complexity of Operation*

This dump removal is of moderate complexity, owing to the steep terrain, narrow access roads and dump face at the angle of repose. Additionally, the restoration component increases overall project complexity.

7.2.2.4 *Accessibility*

Construction will necessarily need to be completed during the summer and fall months owing to snow preventing access otherwise. Access to the DMEA dump will require reopening of existing access roads and roads that would be used to transport the material.

7.2.2.5 *Administrative Feasibility*

From an administrative standpoint, this design alternative would be relatively straight-forward to construct. Consultations with appropriate State of Idaho and Federal agencies may be required for approval of the EPP and for stream channel restoration. No offsite treatment, storage, or disposal services would be required because waste rock from the DMEA dump would be moved to the Northwest Bradley dumps. The technologies, equipment, and specialists needed to complete the project are readily available.

7.2.3 Cost

The estimated cost to partially remove the DMEA dump and construct a channel (D-2) is $360,000 (Table 7-2) and would require approximately 3 weeks to complete. Time estimates assume concurrent phasing of activities, which may not occur. The cost estimate was developed using first principals based on equipment and labor rates published in the USDA-FS Cost Estimating Guide for Road Construction (USDA-FS, 2020) and vendor quotes for consumables. Contingencies considered EPA guidance (USACE and EPA, 2000), modified as appropriate to account for site-specific conditions.

Table 7-2 Design Alternative D-2 Cost Estimate

Cost Item / Footnote	Description	Quantity	Units	Duration (days)	Unit Cost	Cost ($)
1	Salvage organic materials, establish erosion controls, develop access, and manage water	3.0	acre	3	$17,555	$52,666
2	Excavate DMEA	9,980	yd^3	7	$5.85	$58,433
3	Excavate and shape channel	67	yd^3	2	$96.70	$6,459
4	Load, haul, place backfill for geomembrane	84	yd^3	2	$86.77	$7,245
5	Line channel with geomembrane	437	yd^2	4	$38.17	$16,681
6	Screen, load, haul, place base fill on geomembrane	48	yd^3	1	$90.74	$4,394
7	Crush, screen, load, haul, place riprap on base fill	97	yd^3	2	$96.29	$9,327
8	Upland revegetation	1.20	acre	2	$6,825	$8,191
9	Near-stream revegetation	0.10	acre	1	$71,300	$7,562
					Equipment, Labor, & Supplies	**$170,958**
					Mobilization / Demobilization (8.0%)	$13,677
					Remote Site Room & Board	$31,500
					Engineering (10.0%)	$17,096
					Overhead (15.0%)	$25,644
					Construction Monitoring (5.0%)	$8,548
					Annual Post Construction Maintenance (2.5%)	$4,274
					Annual Maintenance NPV (5 years)	$20,382
					Subtotal	**$287,805**
					Contingency (25.0%)	$71,951
					Total Estimated Cost	**$359,756**

Footnotes

Note: All equipment listed below includes operator cost.

1 - Cost based on using a 350-HP dozer with ripper attachment, a 48-HP skid steer, a 14-ft blade grader, two laborers, a survey crew, 400-ft 6-in. polypipe, water diversion structure, and erosion controls.

2 - Cost based on using a 4-yd3 excavator (80% productivity), two 40-ton trucks, 1.5-mile round-trip haul, a 350-HP dozer with ripper attachment, a 4,000-gal water truck (50%), a laborer, and survey crew (25%).

3 - Cost based on using a 3-yd^3 excavator, a 40-ton truck (50%), and two laborers.

4 - Cost based on using a 3-yd^3 excavator, a 40-ton truck (50%), a 48-HP skid steer (50%), and two laborers.

5 - Cost based on using a 99-HP backhoe, a 48-HP skid steer (50%), three laborers, and GCL geotextile.

6 - Cost based on using a 3-yd^3 excavator, 40-ton truck (50%), a 48-HP skid steer (50%), two laborers, a 110-HP screen plant assuming 50% reject supported with a 5-yd^3 loader and 350-HP dozer with ripper attachment (50%).

7 - Cost based on using a 3-yd^3 excavator, a 40-ton truck (50%), a 48-HP skid steer (50%), two laborers, a 110-HP screen plant with rock crusher assuming 60% reject supported with a 5-yd^3 loader and 350-HP dozer with ripper attachment (50%).

8 - Cost based on using a 115-HP mulcher, 48-HP skid steer, two laborers, upland seed mix, fertilizer, and 321 plants per acre.

9 - Cost based on using a 115-HP mulcher, 48-HP skid steer, two laborers, floodplain seed mix, and 4,840 plants per acre.

7.3 SMELTER FLATS / HANGAR FLATS DIVERSION

Given the limited options available for this TCRA site Perpetua elected to not develop multiple design alternatives and proposed to construct Design Alternative S-1 (Channel Along North Side of Smelter Flats). This diversion project will be effective and implementable with similar challenges posed as described for the other diversion channels and liner systems described for the other TCRA diversion projects, save for limited workspace discussed for DMEA, as the Smelter Flats site is readily accessible from open and gently-sloping terrain. The design to guide the construction effort is relatively straightforward as would be the construction, designed to capture surface inflow from the adjacent drainages and hillslope to the north of Smelter Flats. The benefits of implementing this action will be immediate once construction is complete, through reduced inputs from seepage to shallow groundwater and reduced metals loading to Meadow Creek and the EFSFSR.

7.3.1 Effectiveness

7.3.1.1 *Overall protection of human health and the environment*

There is no risk to human health. Reducing the metals loads to Meadow Creek via diversion of surface water around the millsite will improve receiving water quality, which would decrease environmental risks. However, environmental risks would remain due to precipitation onto the millsite and interaction with shallow groundwater.

7.3.1.2 *Compliance with ARARs*

Chemical-specific ARARs for surface water quality at the outlet of this diversion would not be met by this design alternative due to existing up-gradient surface water exceedances. Location-specific ARARs related to construction activity in wetlands would be met. Action-specific ARARs for control of fugitive dust would be met. BMPs would be used to manage storm water runoff and sediment during construction.

7.3.1.3 *Long-term effectiveness and permanence*

The lined diversion would reduce leaching and migration of metals and subsequent release to surface water, thereby reducing residual risk. Installation of a lined channel would be an adequate and reliable diversion system that would be viable over the long term. The RAO to design removal actions that provide for long-term physical stability and have low maintenance requirements would be achieved.

7.3.1.4 *Reduction of toxicity, mobility, or volume through treatment*

No treatment would be implemented under this design alternative.

7.3.1.5 *Short-term effectiveness*

There would be no risks to nearby communities during implementation of the removal actions. Risks to construction workers from contaminated material during construction activities would be mitigated using standard health and safety protocols. Short-term environmental impacts related to construction such as dust generation and storm water runoff would be mitigated using standard BMPs. Perpetua has prepared an EPP that outlines the various measures to be taken to protect fisheries, aquatic life, and stream water quality during construction of the TCRAs. The RAO to reduce contact of surface water with mine waste would be achieved immediately upon completion of construction. The RAO to reduce sources of metals to local surface water and groundwater would also be met immediately, with continued decreases over the first few years as the effects move downgradient.

7.3.2 Implementability

7.3.2.1 *Technical Feasibility*

Standard earth-moving equipment (backhoes, dozers, loaders, trucks) will be used to construct this design alternative. Construction personnel will have standard skills with specialized labor required to install and test the geosynthetic liner. It is anticipated this design alternative can be constructed and made operational within one construction season. Materials and supplies needed are readily available, pending supply chain issues associated with COVID-19-related disruptions. Significant project delays could occur if hazardous materials are encountered along the channel alignment.

7.3.2.2 *Infrastructure Requirements*

Off-site power will not be required to support construction of this design alternative. Access roads to allow improvements to the corridor in which the diversion would be constructed may need improvement to allow heavy equipment to mobilize to the feature.

7.3.2.3 *Reliability and Complexity of Operation*

The design of this design alternative is relatively simple and has been constructed at numerous locations. Operation will be generally passive and simple with no maintenance required to maintain the functionality of the diversion.

7.3.2.4 *Accessibility*

Construction will necessarily need to be completed during the summer and fall months owing to snow preventing access otherwise.

7.3.2.5 *Administrative Feasibility*

From an administrative standpoint, this design alternative would be relatively straight-forward to construct. Consultations with appropriate State of Idaho and Federal agencies may be required for approval of the EPP. No offsite treatment, storage, or disposal services would be required, unless hazardous materials are encountered along the channel alignment. The technologies, equipment, and specialists needed to complete the project are readily available

7.3.3 Cost

The estimated cost to construct approximately 1,390 ft of diversion channel at Smelter Flats is $409,000 (Table 7-3). This will require approximately 5 weeks to complete based on a 7 day per week, day-shift-only work schedule assuming concurrent phasing of activities. The cost estimate was developed using first principals based on equipment and labor rates published in the USDA-FS Cost Estimating Guide for Road Construction (USDA-FS, 2020) and vendor quotes for consumables. Contingencies considered EPA guidance (USACE and EPA, 2000), modified as appropriate to account for site-specific conditions.

Table 7-3 Design Alternative S-1 Cost Estimate

Cost Item / Footnote	Description	Quantity	Units	Duration (days)	Unit Cost	Cost ($)
1	Salvage organic materials, establish erosion controls, develop access, and manage water	2.0	acre	2	$21,889	$43,777
2	Excavate and shape channel	644	yd^3	13	$77.36	$49,818
3	Load, haul, place backfill for geomembrane	274	yd^3	5	$86.77	$23,776
4	Line channel with geomembrane	849	yd^2	8	$37.13	$31,542
5	Screen, load, haul, place base fill on geomembrane	125	yd^3	3	$90.74	$11,342
6	Crush, screen, load, haul, place riprap on base fill	250	yd^3	5	$96.29	$24,073
7	Near-stream revegetation	0.32	acre	2	$4,437	$4,437
					Equipment, Labor, & Supplies	**$188,766**
					Mobilization / Demobilization (8.0%)	$15,101
					Remote Site Room & Board	$44,500
					Engineering (10.0%)	$18,877
					Overhead (15.0%)	$28,315
					Construction Monitoring (5.0%)	$9,438
					Annual Post Construction Maintenance (2.5%)	$4,719
					Annual Maintenance NPV (5 years)	$22,505
					Subtotal	**$327,502**
					Contingency (25.0%)	$81,875
					Total Estimated Cost	**$409,377**

Footnotes

Note: All equipment listed below includes operator cost.

1 - Cost based on using a 350-HP dozer with ripper attachment, a 48-HP skid steer, a 14-ft blade grader, two laborers, a survey crew, 500-ft 6-in. polypipe, water diversion structure, and erosion controls for the entire length of channel.

2 - Cost based on using a 3-yd^3 excavator, a 40-ton truck (50%), and two laborers.

3 - Cost based on using a 3-yd^3 excavator, a 40-ton truck (50%), a 48-HP skid steer (50%), and two laborers.

4 - Cost based on using a 99-HP backhoe, a 48-HP skid steer (50%), three laborers, and 60-mil DST geotextile.

5 - Cost based on using a 3-yd^3 excavator, 40-ton truck (50%), a 48-HP skid steer (50%), two laborers, a 110-HP screen plant assuming 50% reject supported with a 5-yd^3 loader and 350-HP dozer with ripper attachment (50%).

6 - Cost based on using a 3-yd^3 excavator, a 40-ton truck (50%), a 48-HP skid steer (50%), two laborers, a 110-HP screen plant with rock crusher assuming 60% reject supported with a 5-yd^3 loader and 350-HP dozer with ripper attachment (50%).

7 - Cost based on using a 115-HP mulcher, 48-HP skid steer, two laborers, upland seed mix, fertilizer, and 321 plants per acre.

8 DESIGN CONSIDERATIONS

Design alternatives for the three diversion projects were developed based on their ability to: (1) satisfy the requirements of the ASAOC; (2) address the RAOs described below; and (3) satisfy the established selection criteria, also discussed below.

8.1 STREAM DIVERSION REMOVAL ACTION OBJECTIVES

The primary goal of the TCRA is to reduce the release of metals by diverting surface water around three historical mining features at the Stibnite Mine: Northwest Bradley Waste Rock Dumps, the DMEA Waste Rock Dump area, and Smelter Flats / Hangar Flats. The specific RAO for the projects is:

- Reduce transport of COCs from the Source Areas into surface water that contribute to unacceptable ecological risks.

In addition, the general response action and project objective from the Statement of Work is:

- Diversion of clean surface water around the mine waste.

Water diversions are designed to divert upgradient water around the following Source Areas:

- Northwest Bradley Dump
- DMEA Dump
- Smelter Flats.
- Removal actions must offer long-term stability and should minimize maintenance requirements over a large range of conditions. Cost effectiveness usually precludes the use of pipes for surface water conveyance where other, more robust, alternatives are available. However, culverts are acceptable design elements where diversions pass beneath roadways as there are no viable, cost-effective alternatives to these crossings. In keeping with these concepts, the following design criterion is a project objective: Design removal actions that provide for long-term physical stability and have low maintenance requirements.

8.2 BASIS FOR DESIGN

This section provides design basis information and conceptual design criteria.

The primary basis for design of the diversion structures is the hydrology of the area. In 2018, Rio Applied Science & Engineering (Rio ASE) prepared a Surface Water Hydrology Report for the Stibnite Gold Project. The purpose of this report was to “summarize statistical analyses, assumptions, and support rationale for development of surface water hydrology within the Stibnite Gold Project (SGP) in central Idaho” (Rio ASE, 2018). The analysis completed by Rio ASE was based on the historical record from six USGS gaging stations on and near the site along with a gage near the town of Yellow Pine, Idaho. The six gages within the SGP area have varying lengths of record (four of the gages had six years of data as of Rio’s 2018 report, one had 13 years, and one had 36 years) while the gage near the town of Yellow Pine had 89 years of data. Monitoring is ongoing; however, 2017 was the flood of record and the additional data collected since 2018 does not meaningfully affect the flood frequency analysis.

Along with analysis of the existing gages within the SGP, Rio ASE prepared regression equations for areas of interest that are located on streams with no USGS gage. For the analysis of peak flows on these streams the following equation was presented:

$$Q_u = B * \left(P_u{}^b * DA_u{}^c\right)^d$$

Where:

Q_u = discharge at recurrence interval (cfs)
B = constant based on regression trend line
P_u = average annual precipitation (in)
DA_u = drainage area (mi^2)
b = exponent for precipitation

Each of the constants and exponents in the above equation are presented by Rio ASE (2021) and vary based on the desired annual exceedance probability or recurrence interval.

Using the constants and exponents for the 100-year event, the equation is expressed as:

$$Q_{100} = 0.0027 * \left(P_u{}^{2.370} * DA_u{}^{0.936}\right)^{1.1051}$$

The 100-year 25-year, and 10-year peak flow events for each of the proposed diversion locations are summarized in Table 8-1.

Table 8-1 Event Flows Using Rio ASE (2018) Regression Equations

Diversion	Q100 (cfs)	Q25 (cfs)	Q10 (cfs)
Hennessy Creek	16.01	14.49	13.57
Hennessy Side Slope	3.38	3.19	3.11
DMEA	2.08	1.99	1.96
Smelter Flats	2.08	1.99	1.96

In 2017, the USGS prepared "Estimating Peak-Flow Frequency Statistics for Selected Gaged and Ungaged Sites in Naturally Flowing Streams and Rivers in Idaho" (USGS, 2017) in cooperation with Idaho Department of Transportation. The purpose of this report was to document peak-flow statistics for selected stream gages and develop regional regression equations that could be used to estimate peak-flow statistics at ungaged sites. This analysis used stream flow data from 192 stream gages on naturally flowing streams and rivers in Idaho. While the regression equations developed in that report are based on a larger data set than those developed by Rio ASE (2018), they also apply to a much larger area. The state of Idaho is split into 7 regions, with the project area located in Region 5. The regression equation provided for Region 5 with a recurrence interval of 100 years is:

$$Q_{100} = 0.00644 * A^{0.936} * P^{2.37}$$

Where:

Q_{100} = discharge for 100-yr event (cfs)
P = average annual precipitation (in)
A = drainage area (mi^2)

The regression equations described above by Rio ASE (2018) and USGS (2017) provide the most definitive estimate for the 100-year peak flow for the three diversions (summarized in Table 8-2). These equations are based on existing flow data on nearby drainage basins that are similarly characterized by steep forested slopes with peak flows driven by snowmelt.

Table 8-2 Summary of Predicted 100-Year Flows (cfs)

Diversion	Rio (2018)	USGS (2017)	Design Value
Hennessy Creek	16.01	16.71	17
Hennessy Side Slope	3.38	4.09	4
DMEA	2.08	2.63	3
Smelter Flats	2.08	2.63	3

Based on this analysis, diversion designs will be prepared using the USGS (2017) regression equation resulting in 17 cfs for Hennessy Creek at its junction with Stibnite Road, 21 cfs for Hennessy Creek at the existing diversion outfall (combination of Hennessy Creek and Hennessy Side Slope calculations), and 3 cfs for DMEA and Smelter Flats.

8.3 TECHNOLOGIES

Stream diversion design alternatives would be implemented using standard and specialty techniques, materials, and equipment.

Site access would be accomplished using existing, active roads parallel to the work areas, reactivating former forestry or mining roads (by cutting vegetation, regrading, and potentially surfacing), or creating new access roads, as required for each site. Access construction and reclamation would use common forestry and earthmoving equipment. Access over the Bradley pit highwall would require specialty skills and equipment including for rappelling.

Excavation, loading, and haulage at the diversion sites and borrow sources would be accomplished using standard equipment sized for the task – generally small (mini-excavator, small excavator or loader, and 10-ton trucks) for DMEA, and potentially larger excavators, loaders, and haul trucks up to 40 tons for Smelter Flats and Hennessy work.

Channel lining may require standard special fittings for handling liner rolls with heavy equipment, and depending on the liner material selected, specialized installers and installation (seaming) equipment. As the channels contemplated are relatively narrow (narrower than typical geosynthetic material roll widths), seaming is expected to be minimal.

Water management during diversion construction may require use of pipes and collection berms to temporarily divert water around the active work area.

Stream restoration will require contractors with skills in restoration revegetation planting, and reclamation of disturbed slopes not receiving riprap or lining will require standard hydroseeding equipment.

8.4 RESOURCE PROTECTION PROCEDURES

Perpetua developed an EPP (Appendix B) that provides descriptions of overarching measures that will be implemented during removal actions at the Site to ensure protection of human health and the environment. Performance standards and BMPs included in the EPP apply to all phases of the ASAOC implementation. For stream diversion TCRAs, construction is expected to be conducted in accordance with the engineered design requirements and site-specific resource protections.

9 SCHEDULE FOR SELECTED REMOVAL ACTION

The stream diversion projects are proposed to occur in 2022, initiating once snow conditions and vehicular weight restrictions allow mobilization of equipment to the Site. An estimated schedule for the removal activities is summarized below:

Contractor Procurement: December 1 to April 1, 2022

- Mobilization: May 25 to June 1, 2022
- Site Preparation: June 1 to June 5, 2022
- Construction: June 6 to October 1, 2022
- Demobilization: October 1 to October 5, 2022.

Key to meeting this schedule are the following:

- Approval of this work plan by EPA and Forest Service by September 2021.
- Field investigations to fill data gaps will not require permits prior to proceeding.
- Agency approval of final designs for the three diversion projects will be completed by February 2022.
- The lead agencies will complete the formal consultation process to obtain a Biological Opinion from the fisheries agencies prior to contractor procurement, if required.
- Construction contractors are available summer of 2022 and bids to complete the work will be determined to be reasonable and generally in-line with engineers' estimates.
- No unusual wastes (non-mine) will be encountered during construction that would require special treatment as hazardous.
- Suitable borrow materials for construction can be obtained on-site.

10 PROCEDURES FOR PROCESSING DESIGN CHANGES & AGENCY APPROVALS

In the event that changes to the final design of the selected design alternatives are necessary, the changes will be documented with Engineering Change Orders (ECOs) and submitted to the Agencies for review and approval prior to construction and for change orders prepared during construction. The ECOs will describe the proposed design change(s), provide justification for the change(s), and summarize the benefits of the proposed change(s). Agency comments will be incorporate on the ECO (if any), and a final ECO will be issued for Agency signature. Perpetua will work with the Agency representative(s) to collaboratively resolve any substantive design changes identified as necessary during the construction process.

11 PROCEDURES FOR COMPLYING WITH EPA'S OFF-SITE RULE

The Off-Site Rule (40 Code of Federal Regulations 300.440) applies to any removal action involving the off-site transfer of any hazardous substance, or pollutant or contaminant (CERCLA wastes) pursuant to the ASAOC as set forth in Sections 2.5.1, 2.5.2, and 2.5.3 of the Statement of Work (EPA and USDA-FS, 2021). Once a CERCLA waste has been identified, Perpetua will select a disposal facility and coordinate with EPA Region 10 regarding compliance with the Off-Site Rule. EPA Region 10 will use the compliance criteria and release criteria established in the Off-Site Rule to determine the acceptability of the facility selected for disposal of any such wastes. No off-site disposal is proposed under the removal actions.

12 REFERENCES

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Appendix A Engineering Design Documents

Appendix A:

Engineering Design Documents

Stream Diversions

TCRA Action Work Plan

submitted pursuant to

Administrative Settlement and Order on Consent for Removal Actions

(CERCLA Docket No. 10-2021-0034)

Stibnite Mine Site

Stibnite, Valley County, ID

Prepared for:

U.S. Environmental Protection Agency Region 10

United States Department of Agriculture Forest Service Intermountain Region

Prepared by:

Perpetua Resources

405 S 8th St,
Boise, ID, 83702

July 2021

Calculation Cover Sheet

Project: Stream Diversion Projects

Client: Perpetua Resources **Proj. No.** 17-080

Title: Hydrology, Hydraulics and Rip Rap Design

Prepared By, Name: J. Burgi

Prepared By, Signature: ______ **Date:** 6/22/2021

Peer Reviewed By, Name: ______

Peer Reviewed, Signature: ______ **Date:** ______

SUBJECT:	Perpetua Resources	**BY:** J. Burgi	**CHK'D BY:**
	Stream Diversion Projects	**DATE:** 6/4/2021	
		PROJECT NO.: 17-080	

Table of Content

McMILLEN JACOBS ASSOCIATES

SUBJECT:	Perpetua Resources	**BY:**	J. Burgi **CHK'D BY:**
	Stream Diversion Projects	**DATE:**	6/4/2021
		PROJECT NO.:	17-080

Purpose

The purpose of this calculation sheet is to compute an estimated value for the 100-yr event.

References

- *Rio ASE (2018). Surface Water Hydrology Report - Stibnite Gold Project*
- *Wood, Fosness, Skinner, Veilleux. (2017). Estimating Peak-Flow Frequency Statistics for Selected Gaged and Ungaged Sites in Naturally Flowing Streams and Rivers in Idaho. USGS*

Information - Input

The Hennessy Creek watershed contains a small drainage area that ranges in elevation from 6300 feet to 8800 feet. Due to its elevation and geographical location, the peak runoff flows are highly dependent on snow melt in the spring. Rio (2018) prepared a report summarizing the surface water hydrology in the area. The resulting regression equations from this report were used and compared with the regression equations prepared by the USGS (2017) for ungaged streams in Idaho. The contributing drainage areas for the DMEA and Smelter Flats have very similar characteristics.

A_H	0.72	mi^2	Hennessy Creek	GIS Watershed definition
A_{H2}	0.16	mi^2	Hennessy Side Slope	GIS Watershed definition
A_D	0.1	mi^2	DMEA	GIS Watershed definition
A_S	0.1	mi^2	Smelter Flats	GIS Watershed definition
P	31.4	in	Mean annual precipitation	StreamStats (USGS)

Calculation

Surface Water Hydrology Report - Rio ASE (2018)

$$Q_u = B * \left(P_u{}^b * DA_u{}^c\right)^d$$ eq 7-4 (Rio, 2018)

Qu		is discharge (cfs) for the selected frequency
B	0.0027	B is a constant based on regression trend line
Pu	31.4	Pu is the average annual precipitation (in)
DAu	0.72	DAu is drainage area (mi2) for the ungaged site

	100	25	10	
b	2.37	2.42	2.47	b is exponent for precipitation, and
c	0.936	0.941	0.944	c is exponent for drainage area
d	1.1051	1.069	1.0389	d is exponent for power curve

Table 7-2. Constants and Coefficients For Peak Flood Flow Discharge Estimates Regression Equations.

Annual Exceedance Probability	Recurrence Interval (Years)	Variable					
		a	B	b	c	d	R^2
0.995	1.005	0.899[1]	0.0035	2.976	0.925	0.7404	0.970
0.99	1.01	0.899[1]	0.0027	2.980	0.925	0.7714	0.961
0.95	1.05	0.901[1]	0.0017	3.011	0.927	0.8287	0.940
0.9	1.11	0.904[1]	0.0012	3.055	0.930	0.8593	0.926
0.8	1.25	0.908	0.0018	2.840	0.934	0.8946	0.930
0.6667	1.5	0.913	0.0020	2.750	0.939	0.9249	0.927
0.5	2	0.918	0.0021	2.670	0.943	0.9561	0.924
0.4292	2.33	0.919	0.0023	2.630	0.944	0.9645	0.923
0.2	5	0.922	0.0025	2.530	0.945	1.0104	0.918
0.1	10	0.922	0.0027	2.470	0.944	1.0389	0.915
0.04	25	0.921	0.0027	2.420	0.941	1.0692	0.912
0.02	50	0.919	0.0028	2.390	0.939	1.0873	0.910
0.01	100	0.916	0.0027	2.370	0.936	1.1051	0.908
0.005	200	0.914	0.0027	2.350	0.934	1.1210	0.906
0.002	500	0.912	0.0025	2.340	0.931	1.1379	0.903

1. Values were linearly extrapolated from the exponents associated with the 1.25- and 1.5-year recurrence intervals.

	100	25	10		
$Q_{100\text{-}H}$	16.01	14.49	13.57	cfs	Hennessy Creek
$Q_{100\text{-}H2}$	3.38	3.19	3.11	cfs	Hennessy Side Slope
$Q_{100\text{-}D}$	2.08	1.99	1.96	cfs	DMEA
$Q_{100\text{-}S}$	2.08	1.99	1.96	cfs	Smelter Flats

USGS (2017)

$$Q_{10} = 0.00279 * A^{0.944} * P^{2.47}$$

Table 4

$$Q_4 = 0.00420 * A^{0.941} * P^{2.42}$$

$$Q_1 = 0.00644 * A^{0.936} * P^{2.37}$$

Table 4

A 0.72 sq mi
P 31.4 in

	100	25	10		
$Q_{100\text{-}H}$	16.71	12.93	10.19	cfs	Hennessy Creek
$Q_{100\text{-}H2}$	4.09	3.14	2.46	cfs	Hennessy Side Slope
$Q_{100\text{-}D}$	2.63	2.02	1.58	cfs	DMEA
$Q_{100\text{-}S}$	2.63	2.02	1.58	cfs	Smelter Flats

Conclusion

The two regression equation calculations are based on similar information and as a result return very similar peak flows for the 100-year event. The USGS (2017) regression equation will be used for sizing of the hydraulic components of the diversion.

$Q_{100\text{-}H}$	16.71	cfs	Hennessey Creek
$Q_{100\text{-}H2}$	4.09	cfs	Hennessy Side Slope
$Q_{100\text{-}D}$	2.63	cfs	DMEA
$Q_{100\text{-}S}$	2.63	cfs	Smelter Flats

SUBJECT: Perpetua Resources **BY:** J. Burgi **CHK'D BY:**
Stream Diversions **DATE:** 6/4/2021
PROJECT NO.: 17-080

Purpose

The purpose of this calculation sheet is to calculate the open channel hydraulics for the alternatives based on channel geometry and slope.

References

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- *Robinson, K.M. (1989). Design of Rock Chutes, American Society of Agricultural Engineers.*

Information - Input

$Q_{100\text{-}H}$	16.7	cfs	Hennessy Creek
$Q_{100\text{-}H2}$	4.1	cfs	Hennessy Side Slope
$Q_{100\text{-}D}$	2.6	cfs	DMEA
$Q_{100\text{-}S}$	2.6	cfs	Smelter Flats

Calculation

Flow calculations based on Manning's Formula

$$Q = \left(\frac{1.49}{n}\right) A \left(R_h^{\frac{2}{3}}\right) S^{\frac{1}{2}}$$

For each alternative, the profile was split into representative slope groups to calculate the depth of flow based on the flow rate, channel geometry and shape. The Manning's coefficient for Hennessy Alternative 2 was set to 0.025 assuming an irregular surface for the shotcrete.

Each alignment is split into representative reaches based on slope. For each reach, depth and manning's n are assumed and the velocity is calculated. The calculated area is found by dividing the Flow Rate (Q) by the calculated velocity. The initial area and calculated area are compared and the initial depth is iteratively modified until a solution is found.

Mannings n was then calcuated for each reach based on the D50 of the rip rap and the slope (see RipRap sheet).

Hennessy Alt1

Flow Rate, Q = 20.80 cfs Combined Hennessy and Side Slope

Station	Elev	Dist	ΔZ	S	n	d	B	SS	A	Pw	R_h	V (fps)
	ft	ft	ft	ft/ft		ft	ft	SS:1	ft^2	ft		
0	6260	500.0	-12	0.02	0.030	0.97	2.0	2.0	3.80	6.32	0.60	5.48
500	6248	1963.0	-120	0.06	0.039	0.87	2.0	2.0	3.24	5.88	0.55	6.43
2463	6128	437.0	-57	0.13	0.047	0.79	2.0	2.0	2.84	5.54	0.51	7.33
2900	6071											

Manning Coeff, n = 0.025 Shotcrete, wavy section, irregular
Flow Rate, Q = 16.70 cfs Hennessy Creek

Station	Elev	Dist	ΔZ	S	d	B	SS	A	Pw	R_h	V (fps)
	ft	ft	ft	ft/ft	ft	ft	SS:1	ft^2	ft		
0	6259	240	-150	0.63	0.15	10.0	1.0	1.53	10.43	0.15	13.11
240	6109	61	-6	0.10	0.26	10.0	1.0	2.69	10.74	0.25	7.44
301	6103	29	-49	1.69	0.11	10.0	1.0	1.13	10.32	0.11	17.74
330	6054	40	-12	0.30	0.19	10.0	1.0	1.91	10.53	0.18	10.47
370	6042										

DMEA Alt 1

Flow Rate, Q = 2.60 cfs Flow above DMEA

Station	Elev	Dist	ΔZ	S	n	d	B	SS	A	Pw	R_h	V (fps)
	ft	ft	ft	ft/ft		ft	ft	SS:1	ft^2	ft		
0	6633	103	-19.91	0.19	0.047	0.50	0.00	2.00	0.50	2.25	0.22	5.15
103	6613	127	-33.00	0.26	0.050	0.49	0.00	2.00	0.47	2.18	0.22	5.49
230	6580											

Smelter Flat

Flow Rate, Q = 2.60 cfs Flow from Smelter Flats hillside

Station	Elev	Dist	ΔZ	S	n	d	B	SS	A	Pw	R_h	V (fps)
	ft	ft	ft	ft/ft		ft	ft	SS:1	ft^2	ft		
0	6640	524	-3.50	0.01	0.021	0.50	1.00	2.00	0.99	3.22	0.31	2.64
524	6636	244	-41.40	0.17	0.043	0.31	1.00	2.00	0.51	2.40	0.21	5.09
768	6595	622	-20.80	0.03	0.030	0.40	1.00	2.00	0.71	2.77	0.26	3.66
1390	6574											

SUBJE	Perpetua Resources	**BY:**	J. Burgi **CHK'D BY:**
	Stream Diversions	**DATE:**	6/4/2021
		PROJECT NO.:	17-080

Purpose

The purpose of this calculation sheet is to calculate freeboard for the diversions based on 1 foot above 25-yr flow or 6 inches above 100-yr flow

References

- *Chow, Ven Te (1959). Open Channel Hydraulics, McGraw Hill*
- *Robinson, K.M. (1989). Design of Rock Chutes, American Society of Agricultural*

Information - Input

$Q25_{-H}$	12.9	cfs	Hennessy Creek
$Q25_{-H2}$	3.1	cfs	Hennessy Side Slope
$Q25_{-D}$	2.0	cfs	DMEA
$Q25_{-S}$	2.0	cfs	Smelter Flats

Calculation

Flow calculations based on Manning's Formula

$$Q = \left(\frac{1.49}{n}\right) A \left(R_h^{\frac{2}{3}}\right) S^{\frac{1}{2}}$$

For each alternative, the profile was split into representative slope groups to calculate the depth of flow based on the flow rate, channel geometry and shape. The Manning's coefficient for Hennessy Alternative 2 was set to 0.025 assuming an irregular surface for the shotcrete.

Each alignment is split into representative reaches based on slope. For each reach, depth and manning's n are assumed and the velocity is calculated. The calculated area is found by dividing the Flow Rate (Q) by the calculated velocity. The initial area and calculated area are compared and the initial depth is iteratively modified until a solution is found.

Hennessy Alt1

Flow Rate, Q = 16.00 cfs Combined Hennessy and Side Slope

Station	Elev	Dist	ΔZ	S	n	d	B	SS	A	Pw	R_h	V (fps)
	ft	ft	ft	ft/ft		ft	ft	SS:1	ft^2	ft		
0	6260	500.0	-12	0.02	0.030	0.85	2.0	2.0	3.13	5.79	0.54	5.11
500	6248	1963.0	-120	0.06	0.039	0.76	2.0	2.0	2.67	5.40	0.50	5.99
2463	6128	437.0	-57	0.13	0.047	0.69	2.0	2.0	2.35	5.10	0.46	6.82
2900	6071											

Hennessy Alt2

Manning Coeff, n = 0.025 Shotcrete, wavy section, irregular
Flow Rate, Q = 12.90 cfs Hennessy Creek

Station	Elev	Dist	ΔZ	S	d	B	SS	A	Pw	R_h	V (fps)
	ft	ft	ft	ft/ft	ft	ft	SS:1	ft^2	ft		
0	6259	240	-150	0.63	0.12	10.0	1.0	1.17	10.33	0.11	11.03
240	6109	61	-6	0.10	0.20	10.0	1.0	2.06	10.57	0.19	6.28
301	6103	29	-49	1.69	0.09	10.0	1.0	0.87	10.24	0.08	14.92
330	6054	40	-12	0.30	0.14	10.0	1.0	1.46	10.41	0.14	8.82
370	6042										

DMEA Alt 1

Flow Rate, Q = 2.00 cfs Flow above DMEA

Station	Elev	Dist	ΔZ	S	n	d	B	SS	A	Pw	R_h	V (fps)
	ft	ft	ft	ft/ft		ft	ft	SS:1	ft^2	ft		
0	6633	103	-19.91	0.19	0.047	0.46	0.00	2.00	0.41	2.04	0.20	4.82
103	6613	127	-33.00	0.26	0.050	0.44	0.00	2.00	0.39	1.97	0.20	5.15
230	6580											

Smelter Flat

Flow Rate, Q = 2.00 cfs Flow from Smelter Flats hillside

Station	Elev	Dist	ΔZ	S	n	d	B	SS	A	Pw	R_h	V (fps)
	ft	ft	ft	ft/ft		ft	ft	SS:1	ft^2	ft		
0	6638	535	-4.72	0.01	0.021	0.41	1.00	2.00	0.73	2.81	0.26	2.72
535	6633	271	-39.00	0.14	0.043	0.29	1.00	2.00	0.45	2.28	0.20	4.45
806	6594	584	-20.00	0.03	0.030	0.34	1.00	2.00	0.58	2.54	0.23	3.44
1390	6574											

Conclusion

There is no universally accepted rule for determining the amount of freeboard that is needed. FHWA - Design of Roadside Channels with Flexible Linings" suggest that 6" above the design flow is appropriate. Idaho stream alteration rules suggest 1 foot above the 25-year flow. The tables below demonstrate the differences, and the recommended design depth for the channels.

Hennessy Alt1

Station	Total Channel Depth (ft)		
	1' above 25	6" above 100	Design
0	1.85	1.47	2.00
500	1.76	1.37	2.00
2463	1.69	1.29	2.00
2900			

DMEA Alt 1

Station	Total Channel Depth (ft)		
	1' above 25	6" above 100	Design
0	1.46	1.00	1.50
103	1.44	0.99	1.50
230			

Smelter Flat

Station	Total Channel Depth (ft)		
	1' above 25	6" above 100	Design
0	1.41	1.00	1.50
535	1.29	0.81	1.50
806	1.34	0.90	1.50
1390			

SUBJECT:	Perpetua Resources Diversions	**BY:**	J. Burgi **CHK'D BY:**
		DATE:	6/4/2021
		PROJECT NO.:	17-080

Purpose

The purpose of this calculation sheet is to size the riprap for the channel.

References

- *Robinson, K.M. (1989). Design of Rock Chutes, American Society of Agricultural Engineers.*
- *Federal Highway Administration (FHWA). 1989. Design of Riprap Revetment*.
Hydraulic Engineering Circular, No. 11 (HEC-11). U.S. Dept. of Transportation:
- U.S. Army Corps of Engineers (USACE). 1991. *Hydraulic Design of Flood Control Channels*. Engineer Manual 1110-2-1601. Washington D.C., Revised 1994.

Information - Input

$Q_{100\text{-}H}$	16.7	cfs	Hennessy Creek
$Q_{100\text{-}H2}$	4.1	cfs	Hennessy Side Slope
$Q_{100\text{-}D}$	2.6	cfs	DMEA
$Q_{100\text{-}S}$	2.6	cfs	Smelter Flats

Calculation

USACE, Hydraulic Design of Flood Control Channels - EM-1110-2-1601, 1 July 1991

Mild Slope:

$$D_{30} = S_f C_s C_v C_t * d\left(\left(\frac{\gamma_W}{\gamma_S - \gamma_W}\right)^{0.5} * \frac{V}{\sqrt{K_l g d}}\right)^{2.5}$$

Steep slope (2% - 20%):

$$D_{30} = \frac{1.95 S^{0.555} q^{2/3}}{g^{1/3}}$$

D_{50}/D_{30} =	1.3	Stone Size
Sf =	1.25	Safety factor
Cs =	0.3	Stability coefficient for incipient failure, 0.3 angular rock
Cv =	1	Vertical velocity distribution coefficient, 1 for straight channels
Ct =	1	Thickness coefficient, 1 for (1*D100 or 1.5 * D50)
d =		local depth of flow
γ	165	unit weight of stone
γ	62.4	unit weight of water
V =		local depth averaged velocity
θ =	26.6	
ϕ =	40	
K_1 =	0.718	

HEC-11

$$D_{50} = \frac{0.001 * V^3}{\left(d^{0.5} * {K_1}^{1.5}\right)} \quad K_1 = \left[1 - \left(\frac{sin^2\theta}{sin^2\emptyset}\right)\right]^{0.5}$$

Used for flows greater than 1.5 m^3/s - 52.9 cfs

Robinson

0.1 < S <0.4 $$D_{50} = \left(\frac{(q * S^{0.58})}{8.06E-6}\right)^{1/1.89}$$

S < 0.1 $$D_{50} = \left(\frac{(q * S^{1.5})}{9.76E-7}\right)^{1/1.89}$$

Applies to rock chutes constructed with angular riprap with layer thickness of 2D50 for slopes between 2% and 40%. Rock specific gravity ranging between 2.54 and 2.82

$$n = 0.0292 * (D_{50} * S)^{1.47}$$

Hennessy Alt1

Station	S	d	V (fps)
	ft/ft	ft	
0	0.024	0.966	5.48
500	0.0611	0.867	6.43
2463	0.1304	0.792	7.33
2900			

HEC-11	USACE		Robinson	
	Mild	Steep		
D_{50} (in)	D_{50} (in)	D_{50} (in)	D_{50} (in)	n
3.30	NA	3.66	1.92	0.030
5.63	NA	6.37	4.25	0.039
8.72	NA	9.97	7.53	0.047

Average
D_{50} (in)
2.96
5.42
8.74

DMEA Alt 1

Station	S	d	V (fps)
	ft/ft	ft	
0	0.193	0.50	5.15
103	0.260	0.49	5.49
230			

HEC-11	USACE		Robinson	
	Mild	Steep		
D_{50} (in)	D_{50} (in)	D_{50} (in)	D_{50} (in)	n
3.80	NA	7.24	5.54	0.047
4.69	NA	NA	6.17	0.050

Average
D_{50} (in)
5.53
5.43

Smelter Flats

Station	S	d	V (fps)
	ft/ft	ft	
0	0.007	0.50	2.64
524	0.170	0.31	5.09
768	0.033	0.40	3.66
1390			

HEC-11	USACE		Robinson	
	Mild	Steep		
D_{50} (in)	D_{50} (in)	D_{50} (in)	D_{50} (in)	n
0.51	0.83	NA	0.32	0.019
4.63	NA	4.88	4.12	0.045
1.54	NA	1.86	1.27	0.030

Average
D_{50} (in)
0.56
4.54
1.56

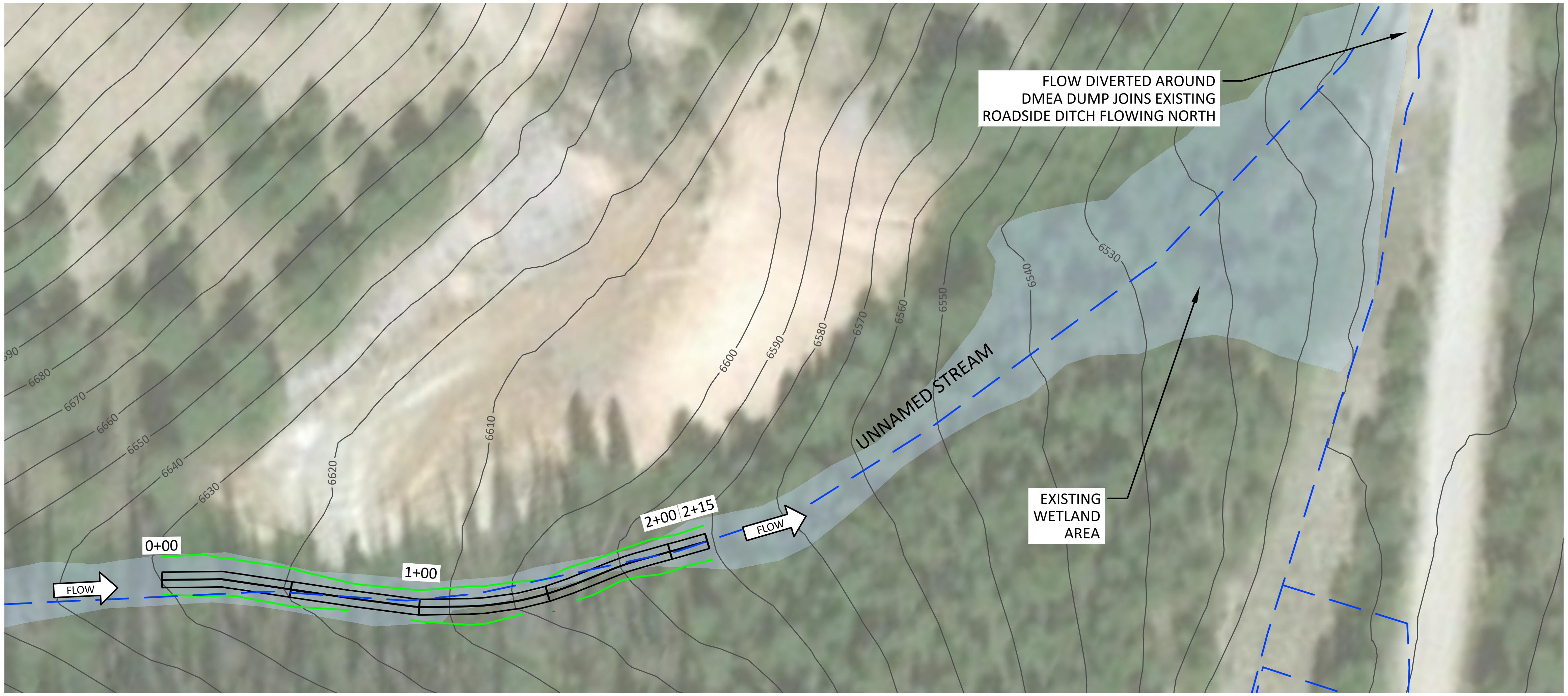
Conclusion

D_{50} = 6in is recommended for the DMEA diversion and for Hennessy Alt1 diversion except for the steep section of the Hennessy diversion where D_{50} = 9.5in should be used. Smaller riprap may be used for Smelter Flats (D_{50} = 3in).

SHEET KEY NOTES:

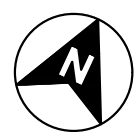
A DITCH TO BE LINED WITH GEOSYNTHETIC LINER, BASE MATERIAL AND RIP RAP SIZED TO BE STABLE AT 100-YR DESIGN FLOW. UPSTREAM AND DOWNSTREAM LIMITS OF WORK AND LINED/UNLINED SEGMENTS WILL BE DETERMINED AFTER STREAM DIVERSION CHANNEL FIELD INVESTIGATIONS.

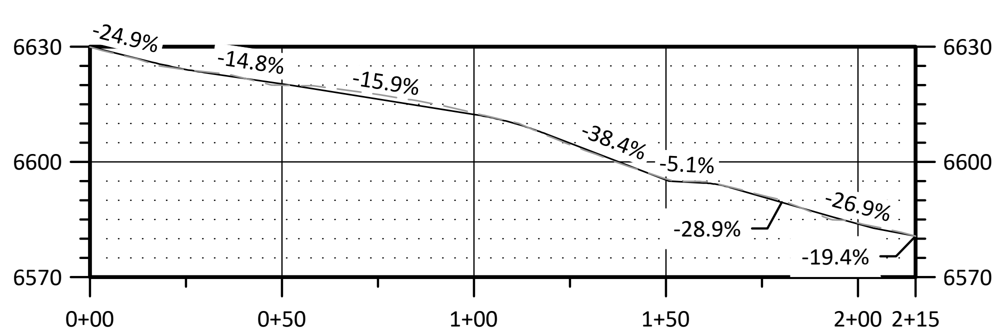
DMEA DIVERSION ALT 1		
ITEM	QUANTITY	UNIT
EXCAVATION - CUT	40	CY
BACKFILL - FILL	50	CY
RIPRAP	58	CY
BASE	29	CY
GEOSYNTHETIC LINER	2,355	SF



PLAN

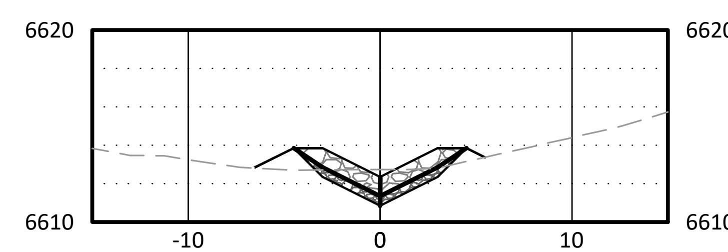
SCALE: 1" = 50'





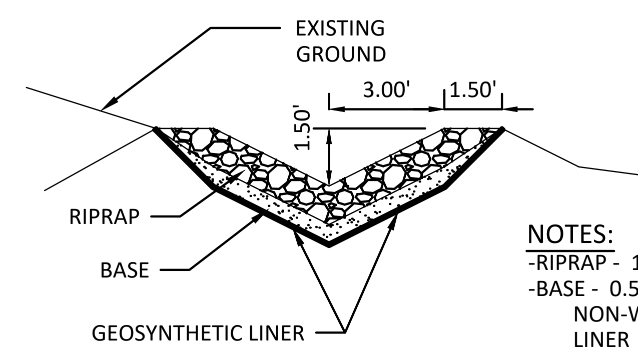
PROFILE

HORZ. SCALE: 1" = 50'
VERT. SCALE: 1" = 50'



SECTION 1+00

SCALE: NTS



NOTES:
-RIPRAP - 1.0' THICK
-BASE - 0.5' THICK GRAVEL OR NON-WOVEN GEOTEXTILE TO PROTECT LINER
-GEOSYNTHETIC LINER TYPE AND NEED FOR BEDDING, BASE, AND ANCHORING TO BE DETERMINED IN SUBSEQUENT DESIGN PHASES

TYPICAL SECTION

SCALE: NTS

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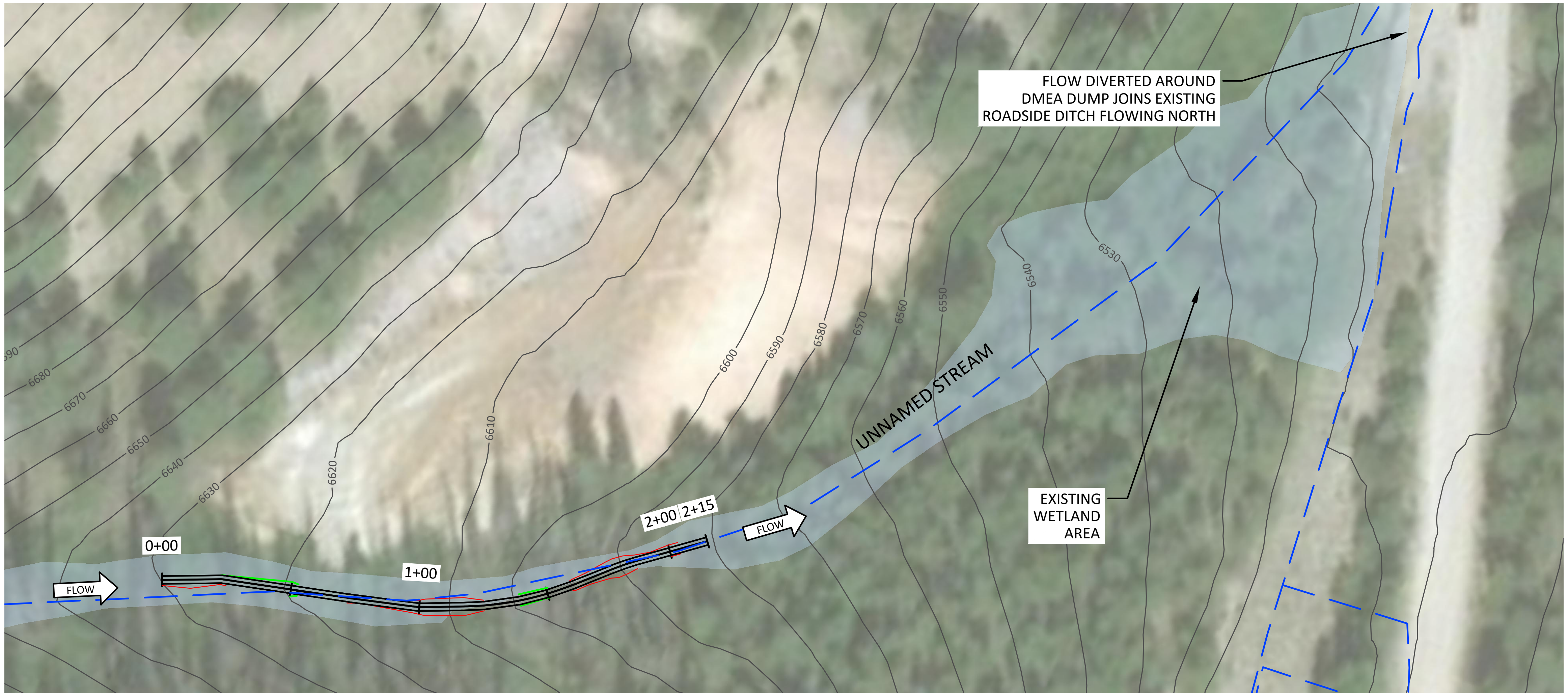
CERCLA PROJECT

DMEA DIVERSION ALTERNATIVE 1

D-1

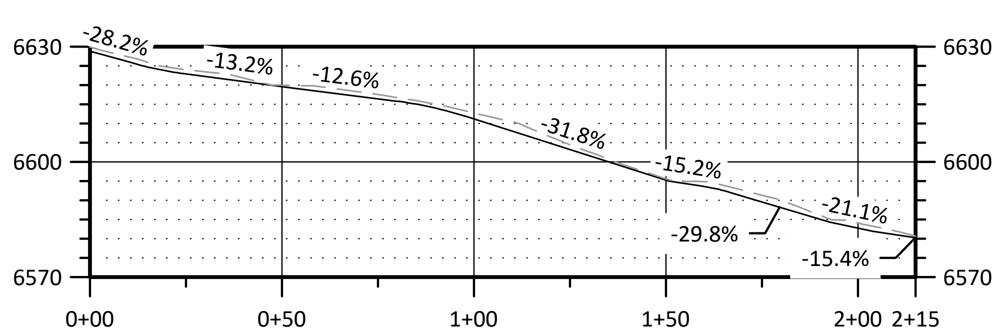
JUNE 2021



PLAN

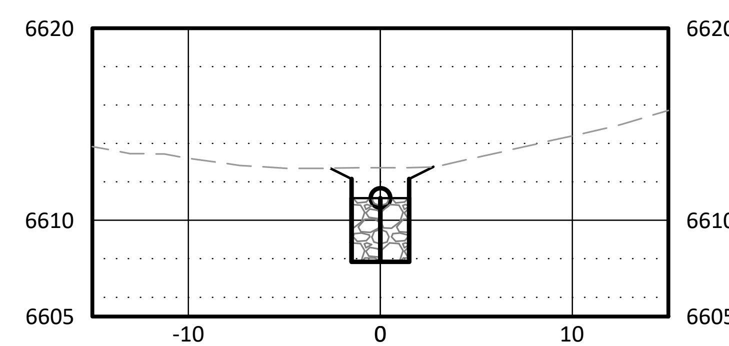
SCALE: 1" = 50'

N



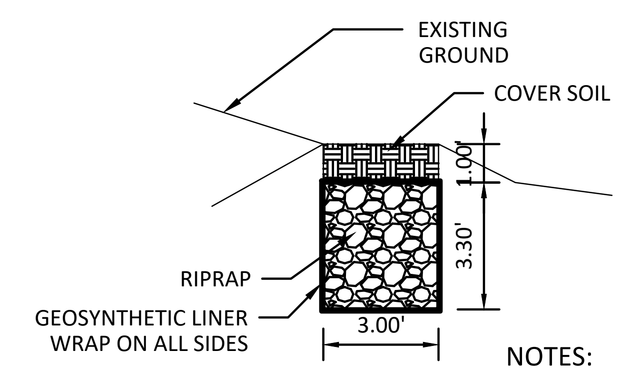
PROFILE

HORZ. SCALE: 1" = 50'
VERT. SCALE: 1" = 50'



SECTION 1+00

SCALE: NTS



NOTES:
-RIPRAP - 3.0' X 3.3'
--GEOSYNTHETIC LINER TYPE AND NEED FOR PROTECTIVE LAYER TO BE DETERMINED IN SUBSEQUENT DESIGN PHASES

TYPICAL SECTION

SCALE: NTS

SHEET KEY NOTES:

A DITCH TO BE LINED WITH GEOSYNTHETIC LINER, BASE MATERIAL AND RIP RAP SIZED TO BE STABLE AT 100-YR DESIGN FLOW. UPSTREAM AND DOWNSTREAM LIMITS OF WORK AND LINED/UNLINED SEGMENTS WILL BE DETERMINED AFTER STREAM DIVERSION CHANNEL FIELD INVESTIGATIONS.

DMEA DIVERSION ALT 1		
ITEM	QUANTITY	UNIT
EXCAVATION - CUT	91	CY
BACKFILL - FILL	7	CY
RIPRAP	76	CY
BASE	0	CY
GEOSYNTHETIC LINER	2,355	SF

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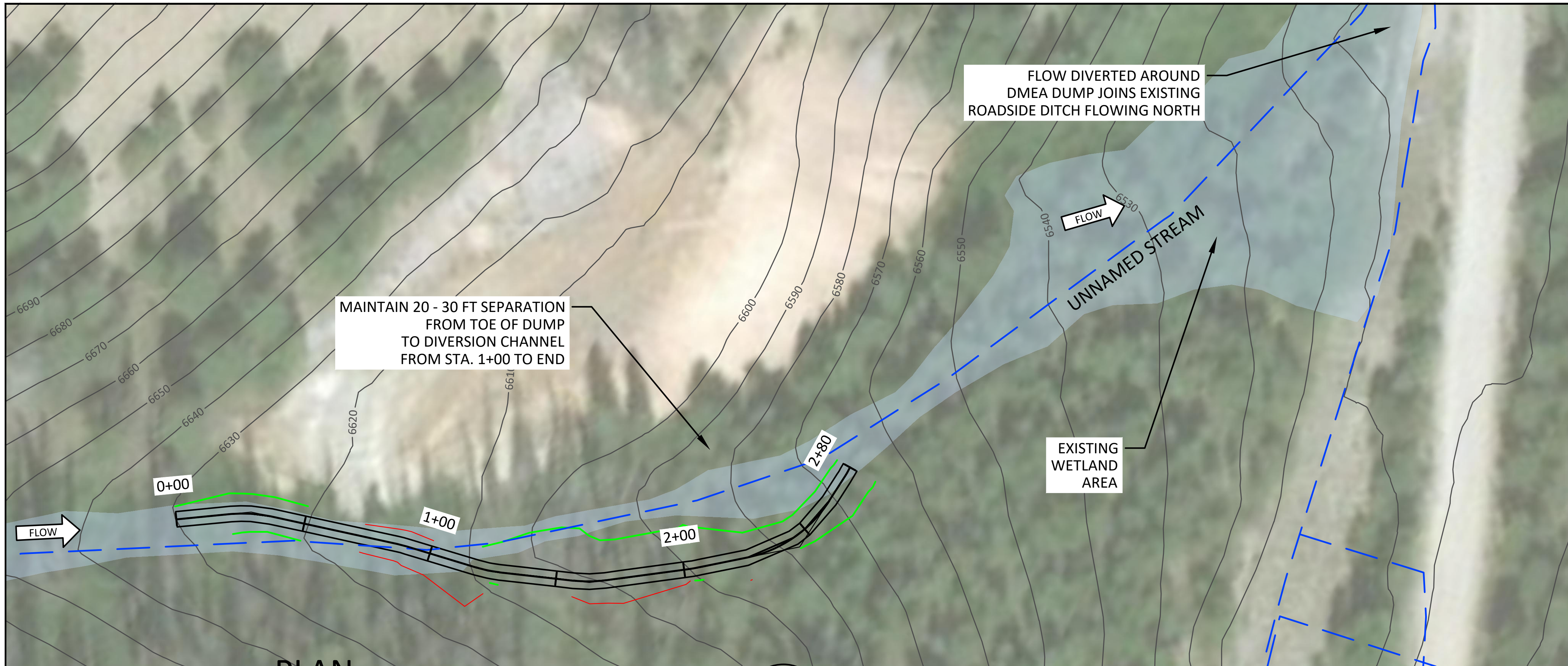
PERPETUA RESOURCES
CERCLA PROJECT
DMEA DIVERSION
ALTERNATIVE 4

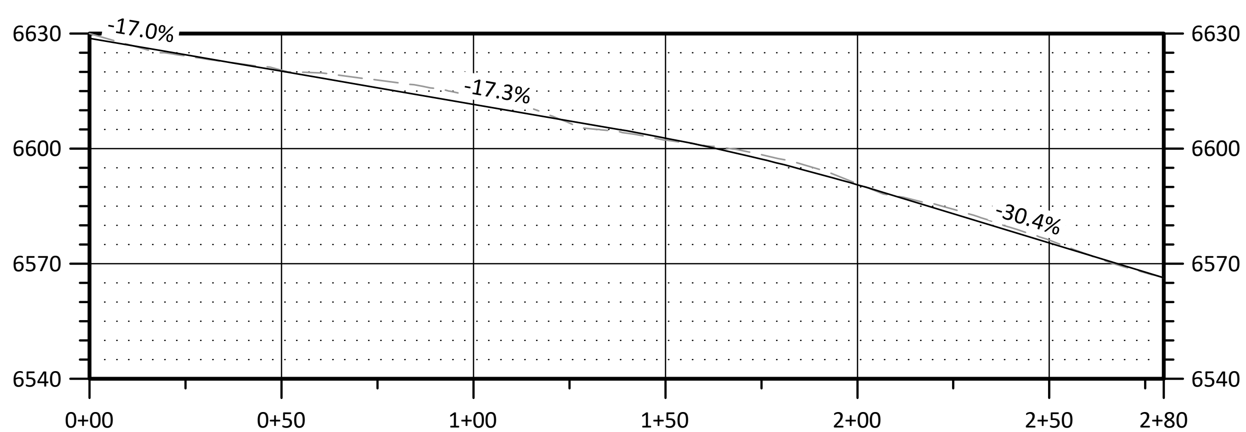
D-4

JUNE 2021



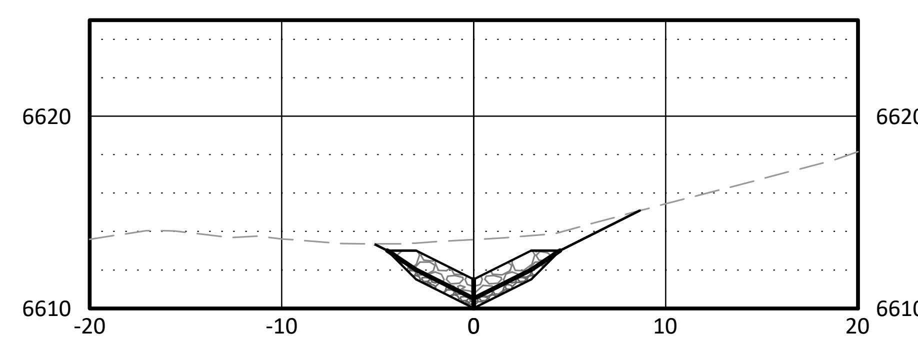
PLAN

SCALE: 1" = 50'



PROFILE

HORZ. SCALE: 1" = 50'
VERT. SCALE: 1" = 50'



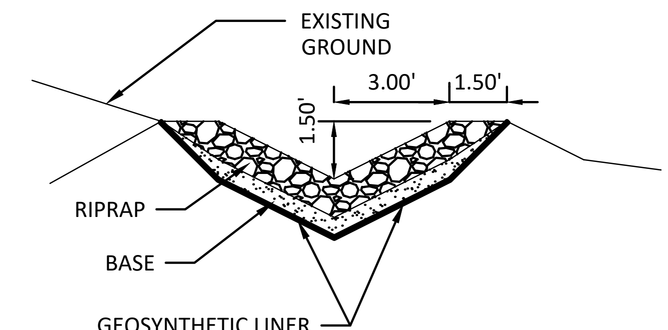
SECTION 1+00

SCALE: NTS

SHEET KEY NOTES:

A DITCH TO BE LINED WITH GEOSYNTHETIC LINER, BASE MATERIAL AND RIP RAP SIZED TO BE STABLE AT 100-YR DESIGN FLOW. UPSTREAM AND DOWNSTREAM LIMITS OF WORK AND LINED/UNLINED SEGMENTS WILL BE DETERMINED AFTER STREAM DIVERSION CHANNEL FIELD INVESTIGATIONS.

DMEA DIVERSION ALT 1		
ITEM	QUANTITY	UNIT
EXCAVATION - CUT	96	CY
BACKFILL - FILL	162	CY
RIPRAP	79	CY
BASE	40	CY
GEOSYNTHETIC LINER	3,080	SF



NOTES:
-RIPRAP - 1.0' THICK
-BASE - 0.5' THICK GRAVEL OR NON-WOVEN GEOTEXTILE TO PROTECT LINER
-GEOSYNTHETIC LINER TYPE AND NEED FOR BEDDING, BASE, AND ANCHORING TO BE DETERMINED IN SUBSEQUENT DESIGN PHASES

TYPICAL SECTION

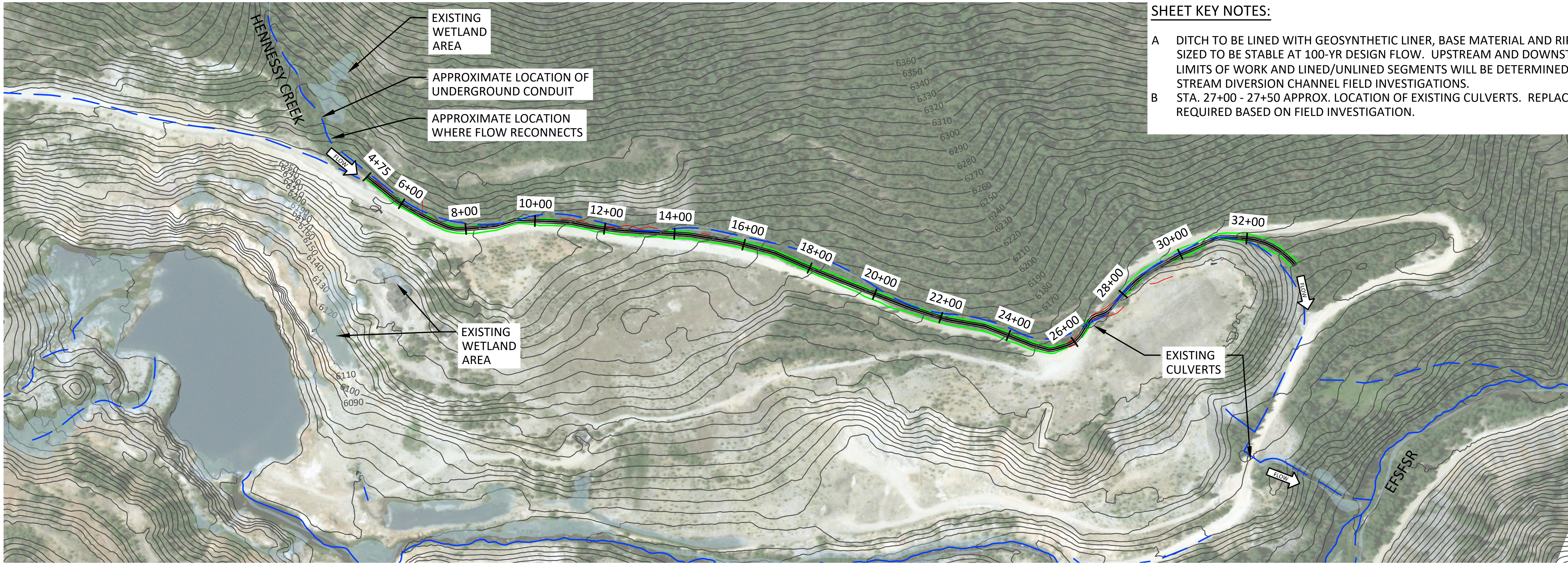
SCALE: NTS

McMILLEN JACOBS ASSOCIATES

PERPETUA RESOURCES
CERCLA PROJECT
DMEA DIVERSION ALTERNATIVE 5

D-5

JUNE 2021



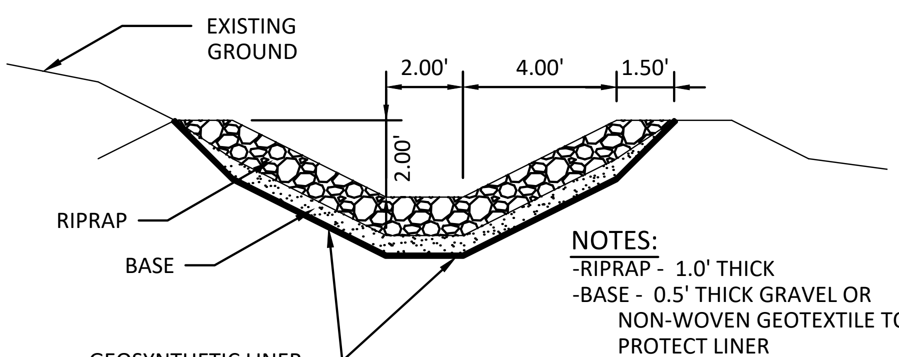
SHEET KEY NOTES:

A DITCH TO BE LINED WITH GEOSYNTHETIC LINER, BASE MATERIAL AND RIPRAP SIZED TO BE STABLE AT 100-YR DESIGN FLOW. UPSTREAM AND DOWNSTREAM LIMITS OF WORK AND LINED/UNLINED SEGMENTS WILL BE DETERMINED AFTER STREAM DIVERSION CHANNEL FIELD INVESTIGATIONS.

B STA. 27+00 - 27+50 APPROX. LOCATION OF EXISTING CULVERTS. REPLACED IF REQUIRED BASED ON FIELD INVESTIGATION.

PLAN

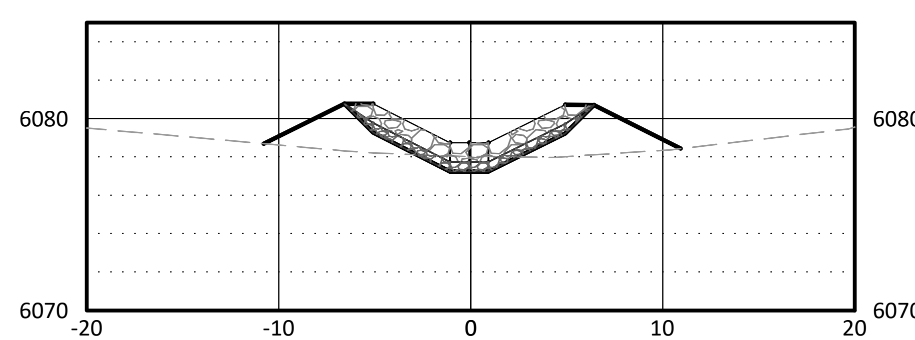
SCALE: 1" = 300'



NOTES:
- -RIPRAP - 1.0' THICK
- -BASE - 0.5' THICK GRAVEL OR NON-WOVEN GEOTEXTILE TO PROTECT LINER
- -GEOSYNTHETIC LINER AND NEED FOR BEDDING, BASE AND ANCHORING TO BE DETERMINED IN SUBSEQUENT DESIGN PHASES

TYPICAL SECTION

SCALE: NTS



SECTION 28+50

SCALE: NTS

HENNESSY DIVERSION ALT 1		
ITEM	QUANTITY	UNIT
EXCAVATION - CUT	1,850	CY
BACKFILL - FILL	1,870	CY
RIPRAP	1,230	CY
BASE	615	CY
GEOSYNTHETIC LINER	43,900	SF

McMILLEN JACOBS ASSOCIATES

PERPETUA RESOURCES

CERCLA PROJECT

HENNESSY CREEK DIVERSION ALTERNATIVE 1 - PLAN VIEW

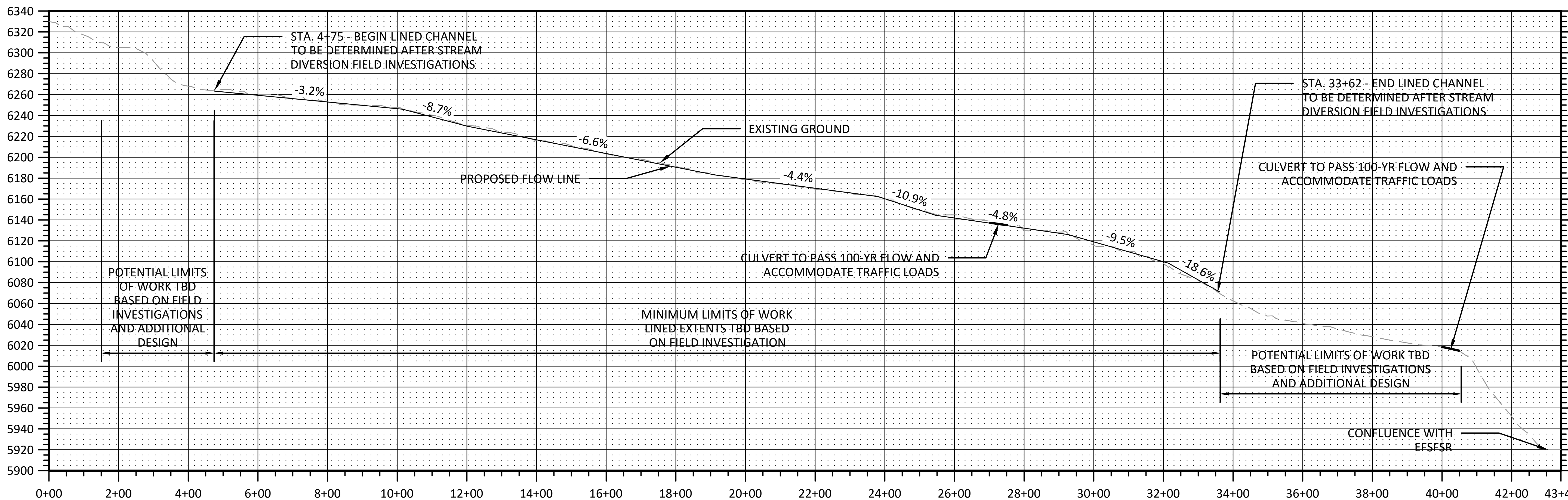
H-1a

JUNE 2021

SHEET KEY NOTES:

A DITCH TO BE LINED WITH GEOSYNTHETIC LINER, BASE MATERIAL AND RIPRAP SIZED TO BE STABLE AT 100-YR DESIGN FLOW. UPSTREAM AND DOWNSTREAM LIMITS OF WORK AND LINED/UNLINED SEGMENTS WILL BE DETERMINED AFTER STREAM DIVERSION CHANNEL FIELD INVESTIGATIONS.

B STA. 27+00 - 27+50 APPROX. LOCATION OF EXISTING CULVERTS. REPLACED IF REQUIRED BASED ON FIELD INVESTIGATION.



PROFILE

HORZ. SCALE: 1" = 300'
VERT. SCALE: 1" = 50'

McMILLEN JACOBS ASSOCIATES

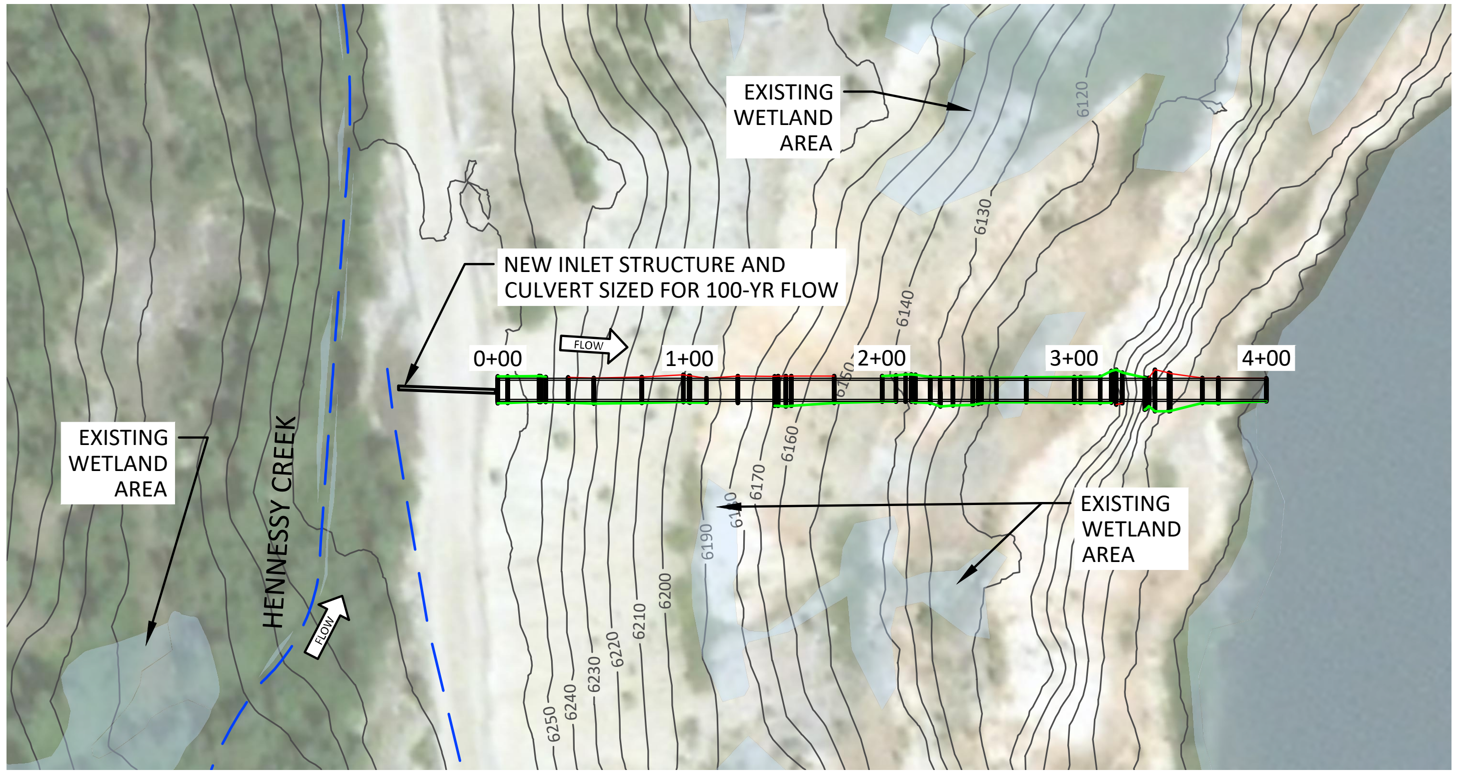
PERPETUA RESOURCES

CERCLA PROJECT

HENNESSY CREEK DIVERSION
ALTERNATIVE 1 - PROFILE

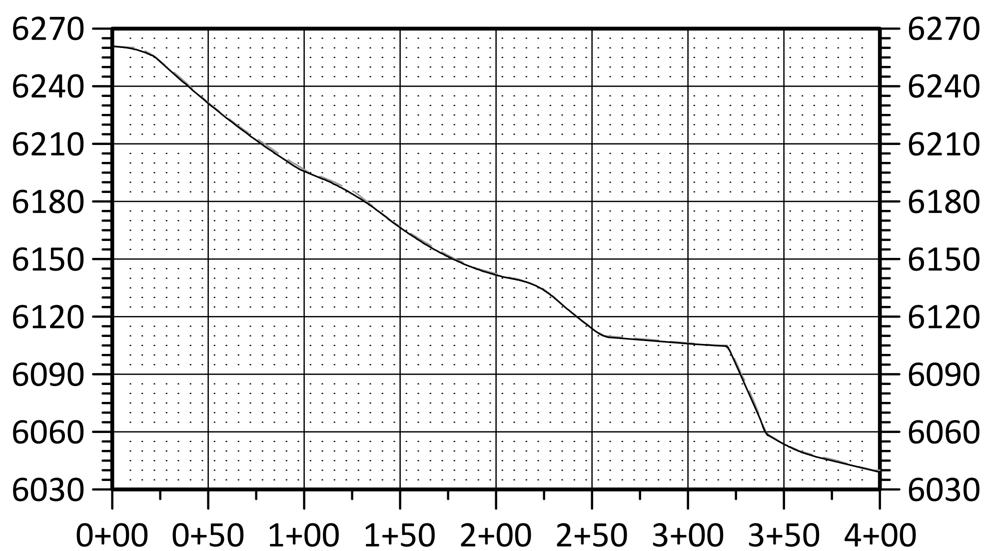
H-1b

JUNE 2021



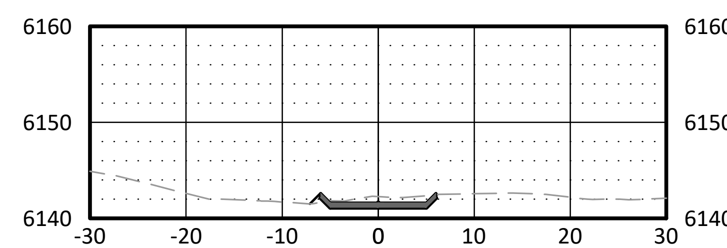
PLAN

SCALE: 1" = 100'



PROFILE

HORZ. SCALE: 1" = 100'
VERT. SCALE: 1" = 100'



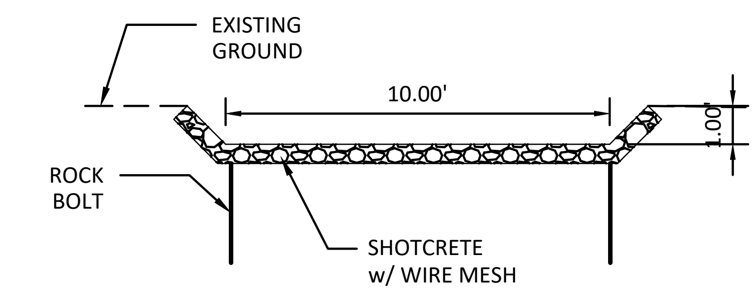
SECTION 2+00

SCALE: NTS

SHEET KEY NOTES:

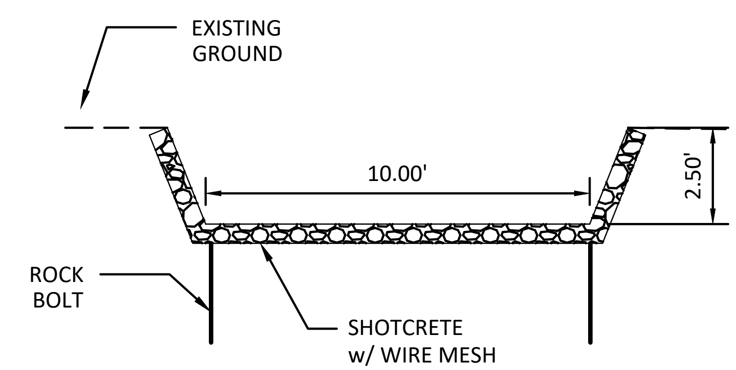
A STA. 0+00 - 4+00 - PREPARE AND SHAPE EXISTING HIGHWALL AND PROTECT WITH SHOTCRETE.
B INSTALL NEW INLET STRUCTURE AND CULVERT TO PASS THE 100-YR DESIGN FLOW.
C DESIGN OUTLET TO TO BE DETERMINED FOR ENERGY DISSIPATION

HENNESSY DIVERSION ALT 2		
ITEM	QUANTITY	UNIT
EXCAVATION - CUT	170	CY
SHOTCRETE w/ WIRE MESH	90	CY
ROCK BOLTS	74	EA
CULVERT	50	LF



TYPICAL STEEP SECTION

SCALE: NTS



TYPICAL FLAT SECTION AT BENCHES

SCALE: NTS

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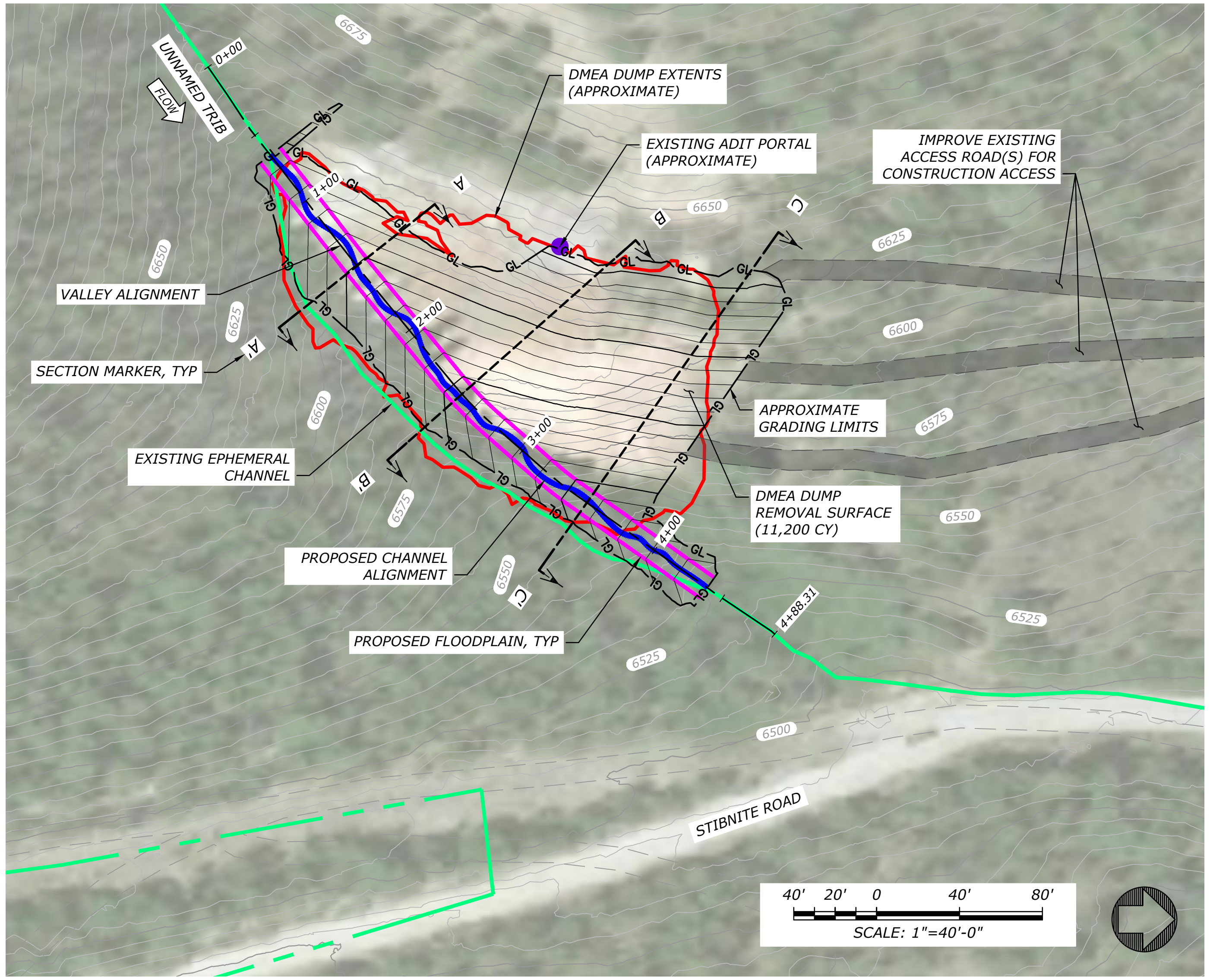
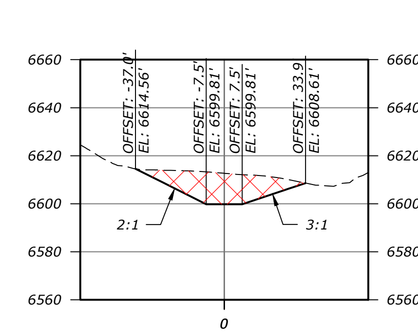
PERPETUA RESOURCES
CERCLA PROJECT
HENNESSY CREEK DIVERSION
ALTERNATIVE 2

H-2

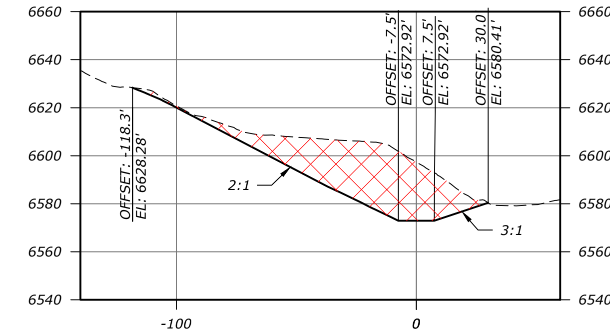
JUNE 2021



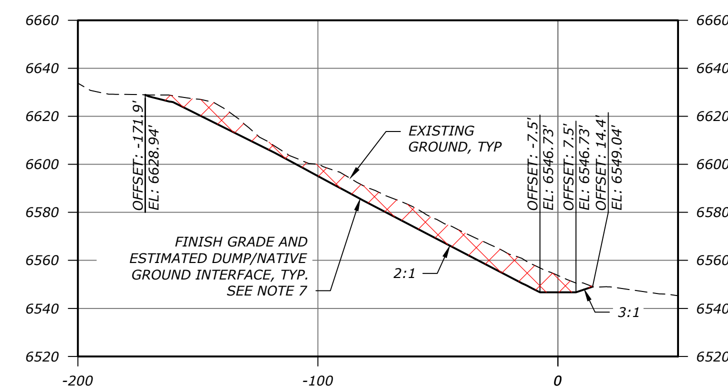
PROPOSED CONDITIONS



SECTIONS A-A'



SECTIONS B-B'



SECTIONS C-C'

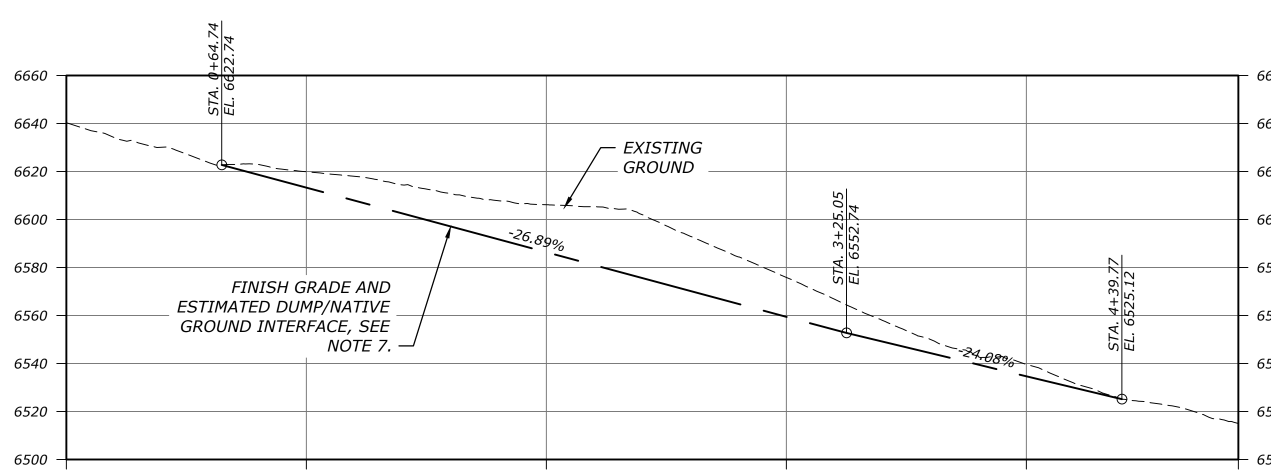
NOTES:
1. PROPOSED CHANNEL OMITTED FROM VALLEY SECTIONS FOR CLARITY.

HORIZONTAL SCALE
40' 20' 0 40' 80'
SCALE: 1"=40'-0"

VERTICAL SCALE
40' 20' 0 40' 80'
SCALE: 1"=40'-0"

VALLEY SECTIONS

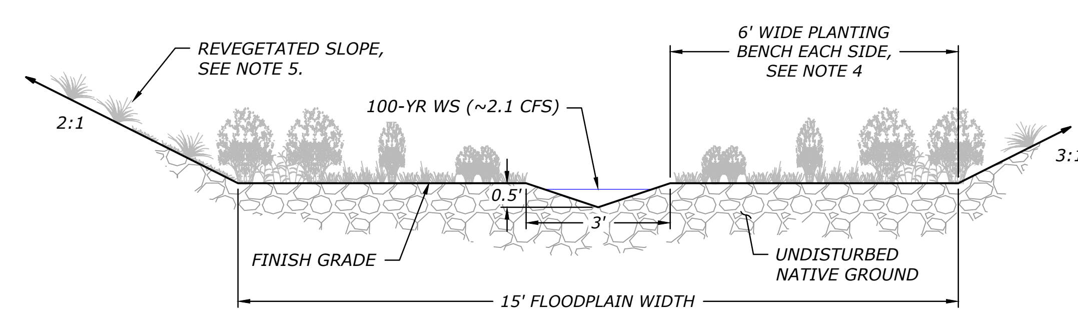
PROPOSED CHANNEL OBJECTIVES					
REACH	VALLEY LENGTH (FT)	CHANNEL LENGTH (FT)	SINUOSITY	VALLEY SLOPE (%)	CHANNEL SLOPE (%)
DMEA DUMP SITE EPHEMERAL CHANNEL	375	385	1.03	26.0	25.4



HORIZONTAL SCALE
40' 20' 0 40' 80'
SCALE: 1"=40'-0"

VALLEY PROFILE

VERTICAL SCALE
40' 20' 0 40' 80'
SCALE: 1"=40'-0"



TYPICAL CHANNEL SECTION

NTS

NOTES:
1. THE EXISTING EPHEMERAL STREAM MAY BE PIPED AROUND THE WORK AREA DURING CONSTRUCTION.
2. DUMP MATERIAL WILL BE REMOVED DOWN TO NATIVE MATERIAL AND THE CHANNEL WILL BE CONSTRUCTED WITHIN NATIVE GROUND. IMPORT OF STREAMBED MATERIAL IS NOT ANTICIPATED.
3. ROCK SLOPE ARMORING AT VALLEY TOE NOT ANTICIPATED.
4. REVEGETATION IS EXPECTED TO CONSIST OF ROBUST PLANTING OF ALDERS AND NATIVE SPECIES AT THE VALLEY TOE AND RIPARIAN PLANTING AND SEEDING THROUGHOUT THE 6' WIDE PLANTING BENCH.
5. UPLAND PLANTING AND SEEDING IS ANTICIPATED FOR ALL DISTURBED SLOPES. DISTURBED SLOPES MAY REQUIRE MULCHING AND/OR TACKIFIER.
6. NEW CHANNEL AND FLOODPLAIN WILL BE FIELD-FIT BASED ON ACTUAL DUMP/NATIVE GROUND INTERFACE ENCOUNTERED DURING CONSTRUCTION.
7. DUMP/NATIVE GROUND INTERFACE ESTIMATED FROM BEST AVAILABLE DATA. INTERFACE MAY BE REVISED WITH ADDITIONAL FUTURE FIELD DATA.

Rio Applied Science & Engineering

WORKING DRAFT FOR REVIEW AND REVISION

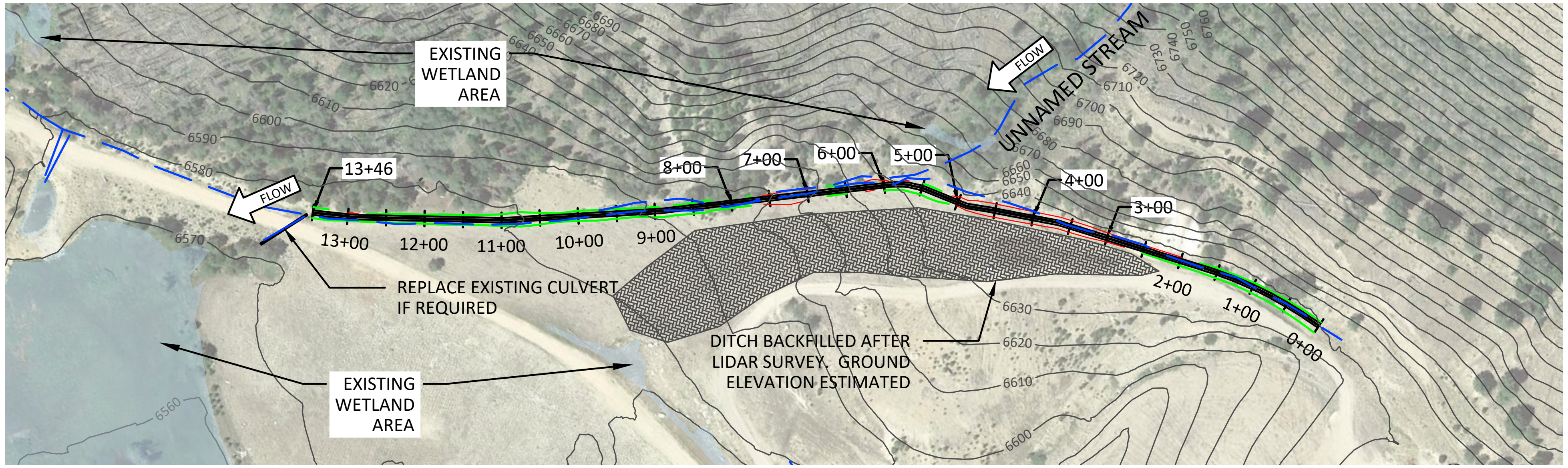
STIBNITE GOLD PROJECT - DMEA DUMP SITE
CONCEPTUAL PROPOSED PLAN
FOR PERPETUA RESOURCES IDAHO, INC
DMEA DUMP SITE CHANNEL
VALLEY COUNTY, ID

DATE: MARCH 2021
DESIGNED: JY
APPROVED: --

DRAWING NAME
DMEA-DUMP

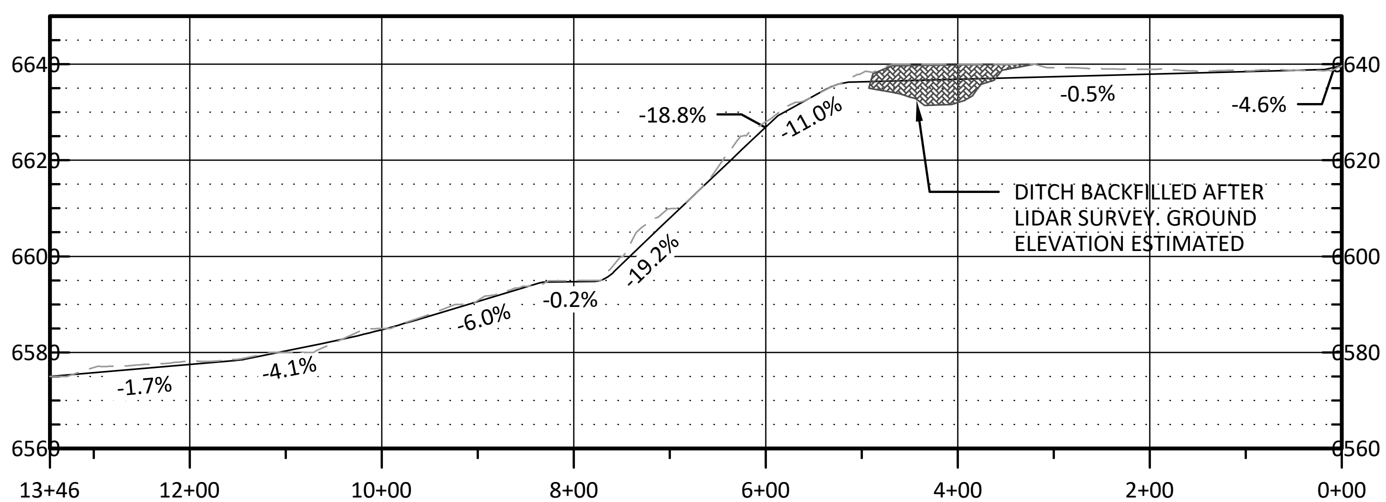
PROPOSED CONDITIONS

DRAWING NO.
C1
SHEET 1 OF 1



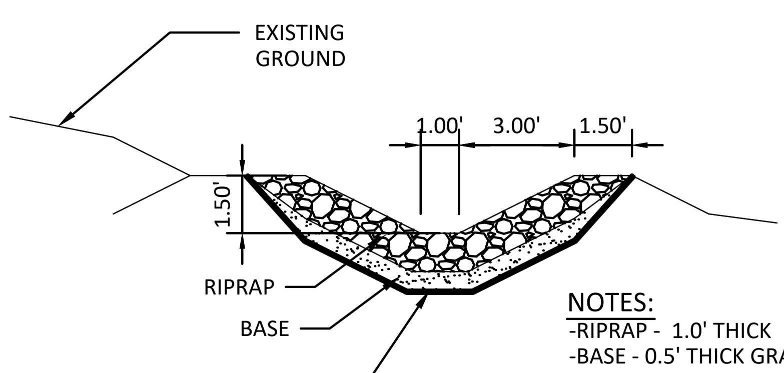
PLAN

SCALE: 1" = 200'



PROFILE

HORZ. SCALE: 1" = 200'
VERT. SCALE: 1" = 40'



NOTES:
- RIPRAP - 1.0' THICK
- BASE - 0.5' THICK GRAVEL OR NON-WOVEN GEOTEXTILE TO PROTECT LINER
- GEOSYNTHETIC LINER TYPE AND NEED FOR BEDDING, BASE, AND ANCHORING TO BE DETERMINED IN SUBSEQUENT DESIGN PHASES

TYPICAL SECTION

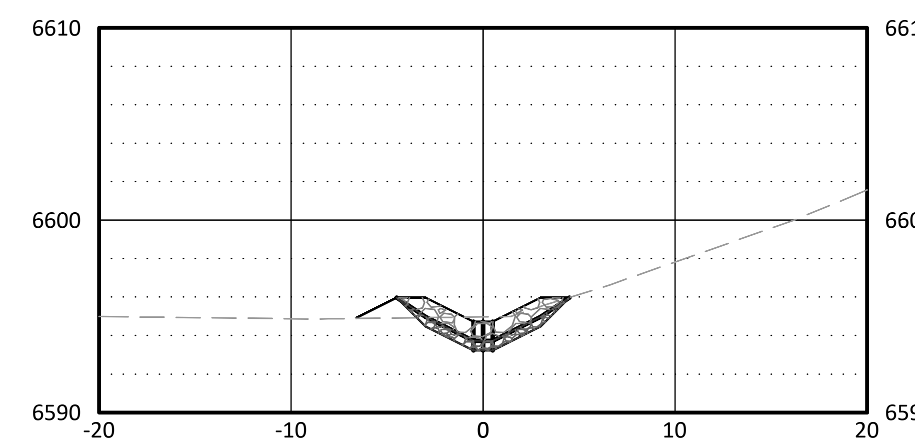
SCALE: NTS

SHEET KEY NOTES:

A DITCH TO BE LINED WITH GEOSYNTHETIC LINER, BASE MATERIAL AND RIPRAP SIZED TO BE STABLE AT 100-YR DESIGN FLOW. UPSTREAM AND DOWNSTREAM LIMITS OF WORK AND LINED/UNLINED SEGMENTS WILL BE DETERMINED AFTER STREAM DIVERSION CHANNEL FIELD INVESTIGATIONS.

B REPLACE EXISTING CULVERT TO PASS 100-YEAR FLOW AND ACCOMMODATE TRAFFIC LOADS IF REQUIRED BASED ON FIELD INVESTIGATION.

SMELTER FLATS ALT 1		
ITEM	QUANTITY	UNIT
EXCAVATION - CUT	640	CY
BACKFILL - FILL	172	CY
RIPRAP	370	CY
BASE	185	CY
GEOSYNTHETIC LINER	16,320	SF



SECTION 8+00

SCALE: NTS

McMILLEN JACOBS ASSOCIATES

PERPETUA RESOURCES
CERCLA PROJECT
SMELTER FLATS DIVERSION ALTERNATIVE 1

S-1

JUNE 2021

Appendix B Environmental Protection Plan

Appendix B:

Environmental Protection Plan

Stream Diversions

TCRA Action Work Plan

submitted pursuant to

Administrative Settlement and Order on Consent for Removal Actions

(CERCLA Docket No. 10-2021-0034)

Stibnite Mine Site

Stibnite, Valley County, ID

Prepared for:

U.S. Environmental Protection Agency Region 10

United States Department of Agriculture Forest Service Intermountain Region

Prepared by:

Perpetua Resources

405 S 8th St,
Boise, ID, 83702

July 2021

Environmental Protection Plan

submitted pursuant to

Administrative Settlement and Order on Consent for Removal Actions

(CERCLA Docket No. 10-2021-0034)

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July 2021

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LIST OF ABBREVIATIONS

ABBREVIATION	DESCRIPTION
ASAOC	Administrative Settlement Agreement and Order on Consent
AST	Above ground storage tank
BMPs	Best management practices
BPA	Bonneville Power Administration
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
DOT	Department of Transportation
EPA	U.S. Environmental Protection Agency
EPP	Environmental Protection Plan
ESA	Endangered Species List

ESOP	Environmental Standard Operating Procedure
IDEQ	Idaho Department of Environmental Quality
IDFG	Idaho Department of Fish and Game
NCP	National Oil and Hazardous Substances Pollution Contingency Plan
NEPA	National Environmental Policy Act
NFS	National Forest System
NMFS	National Marine Fisheries Service
NOAA	National Oceanic and Atmospheric Administration
NPL	National Priorities List
OSC	On-Scene Coordinator
PCF	Project completion form
RCA	Riparian Conservation Area
RMP	Resources Management Plan
SDS	Safety Data Sheet
SGP	Stibnite Gold Project
SPCC	Spill Prevention, Control, and Countermeasure Plan
SWPPP	Stormwater Pollution Prevention Pan
TCRA	Time Critical Removal Action
USDA	U.S. Department of Agriculture
USFS	U.S. Forest Service
USFWS	U.S. Fish and Wildlife Service

1. INTRODUCTION AND PURPOSE

Respondents Perpetua Resources Corp., Perpetua Resources Idaho, Inc. (formerly Midas Gold Corp. and Midas Gold Idaho, Inc. Respectively), Idaho Gold Resources Company, LLC and Stibnite Gold Company (collectively "Perpetua Respondents" or "Perpetua") have prepared this Environmental Protection Plan detailing measures to minimize harm to the environment during implementation of Time Critical Removal Actions (TCRAs) in accordance with the requirements of an Administrative Settlement Agreement and Order on Consent (ASAOC) for Removal Actions with the U.S. Environmental Protection Agency (EPA) and the U.S. Department of Agriculture Forest Service (USFS; EPA 2021). The work is being conducted under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) and the National Oil and Hazardous Substances Pollution Contingency Plan (NCP).

EPA has determined that response actions under the ASAOC are exempted by law from the requirement to obtain Federal, State, or local permits for on-site remedial actions (CERCLA Section 121(e)(1)). However, this does not remove the requirement to meet the substantive provisions of permitting regulations and environmental standards that are established by other regulatory jurisdictions.

The purpose of this Environmental Protection Plan (EPP) is to define and consolidate environmental protection measures relevant to conducting removal actions at the Site. It is intended to detail overarching environmental practices necessary to ensure the protection of human health and the environment, as well as compliance with related environmental agreements. The performance standards and best management practices (BMPs) presented here apply to all phases of the ASAOC implementation. Site specific environmental controls or criteria for each TCRA work element that are unique to the integrity or characteristics of the work element are contained in the individual TCRA Work Plans or resource specific assessments.

2. ACCESS AND TRANSPORTATION

Stibnite is located in remote, mountainous terrain in central Idaho and has limited infrastructure, including roads and facilities. The Site lies within lands managed by the Payette National Forest. There are three existing access routes to the Site from Cascade or McCall, Idaho: the Johnson Creek, South Fork and Lick Creek Routes as shown on Figure 2-1. The Johnson Creek Route is the primary access to the Site during non-winter conditions and relies on Johnson Creek Road (FS 413). The distance from Cascade to Stibnite is approximately 74 miles along this route. The South Fork Route (along FS 474) is the only access to the site in winter months. The distance from Cascade to Stibnite is approximately 96 miles along this route. The Lick Creek route is also available in snow-free months. The distance from McCall to Stibnite along the Lick Creek Route (FS 412) is approximately 67 miles though this route is not proposed to support field activities.

Multiple jurisdictions are responsible for the access routes to the Site, including the State of Idaho, the USFS and Valley County. Access maintenance and improvements are dependent on coordination with the appropriate jurisdiction. The maintenance of certain National Forest System (NFS) roads on the Payette National Forest is coordinated between the USFS and Valley County through Schedule A agreements. This includes 14 miles of roadway between Yellow Pine and Stibnite (FS 412). Perpetua maintains a Road Maintenance Agreement with Valley County for this route that includes general upkeep, dust abatement and snow removal according to the Road Maintenance Standards and BMPs for the Payette National Forest (**Appendix A**).

A large portion of the transportation route for the project is narrow, and unpaved, following river and stream corridors. Within the project area itself, all routes are graveled or unimproved. Temporary access routes for construction will rely on primitive route conditions. Environmental protections for access and transportation are intended to reduce wear on roads and construction access corridors, reduce the potential for accidents and hazardous fuel spills along winding mountain roads, and to preclude erosion and sediment transport from the road system to surface waters.

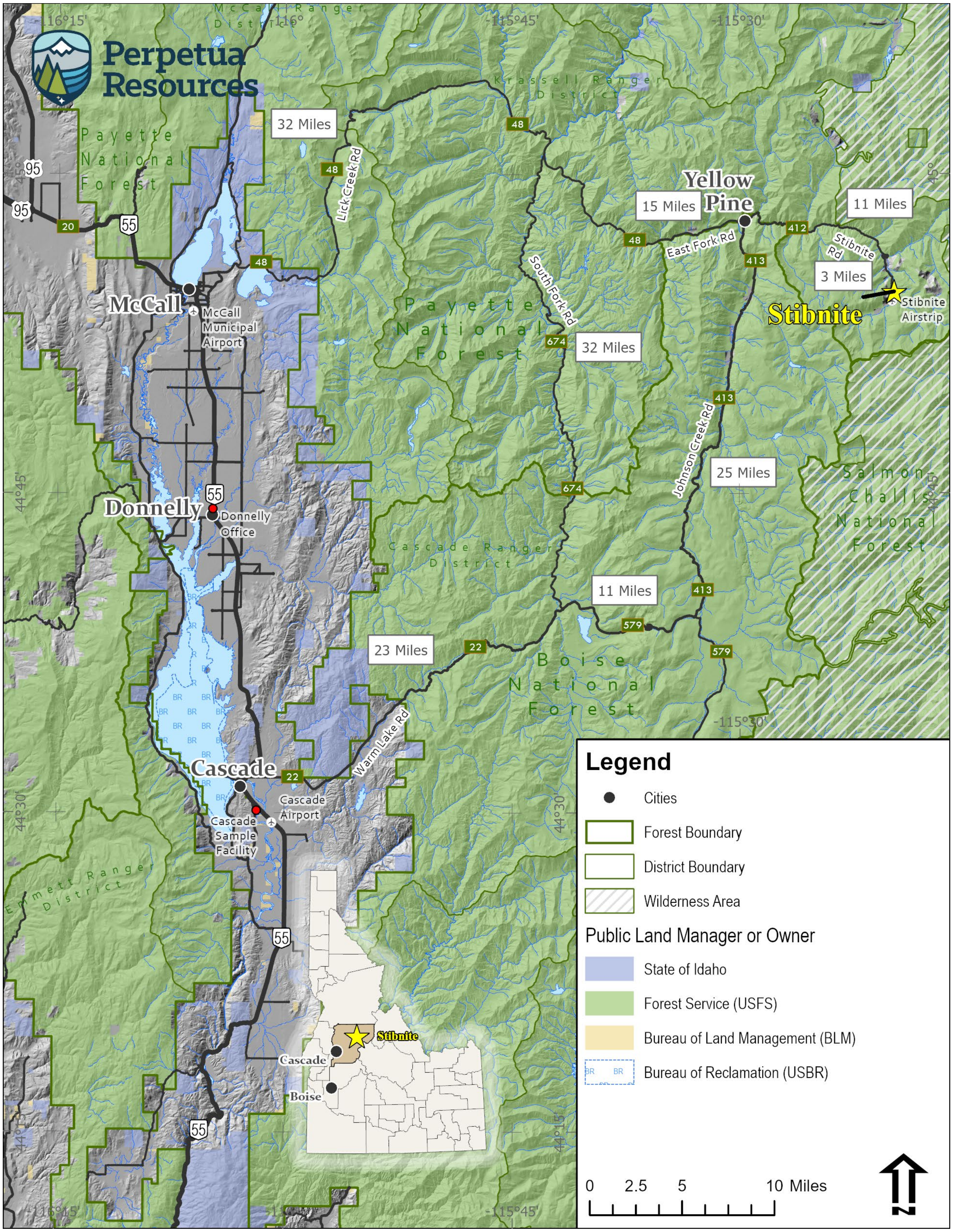

Figure 2-1 Project Location Map

An active private airstrip owned by Perpetua lies adjacent to Meadow Creek near the On/Off Leach Pad . During active haulage operations to the repository, the airstrip will be closed for air traffic. Any scheduled private flights will be coordinated by the site Supervisor and Field Operations Manager. Table 2-1 summarizes environmental protection measures associated with access and transportation that will be implemented during removal actions completed under the ASAOC.

Table 2-1 Access and Transportation Environmental Protection Practices

A.	**Traffic and Access Management**
1.	Perpetua will maintain a strict policy for all employees and contractors to obey approved speed limits.
2.	Road restrictions and load limits will be observed for all project related travel.
3.	Pilot cars will be used during equipment mobilization and demobilization when appropriate. Vehicle to vehicle communication will be maintained for all piloted or convoy transports.
4.	Documented annual inspections of commercial transport vehicles will be required. Commercial transport vehicles will also be inspected by the driver at Knox or Landmark prior to accessing Johnson Creek Road. Transport companies are required to document these local vehicle inspections.
5.	Tire chains will be required for snow or icy road conditions. All project vehicles will be equipped with properly sized chains for both steering and drive tires. It is not uncommon to receive snow in the region during what are considered summer months. Vehicles will be equipped with appropriate tools and equipment in anticipation of weather events.
6.	The South Fork Route from Cascade to Yellow Pine will be used for non-fuel haul project access when Johnson Creek Road is closed due to winter conditions. Commercial fuel hauling will not occur on the South Fork Route in support of ASAOC work.
7.	Vehicles will be equipped with appropriate tools and equipment for fire suppression during dry periods.
8.	All equipment and materials will be kept within construction limits or road areas to protect the work site and environment from damage.
9.	Temporary parking areas will be designated within the work site to accommodate construction personnel and equipment.
B.	**Road Maintenance and Temporary Access** (For those portions of the access route under Perpetua's maintenance authority).
1.	Roadways, temporary staging, storage areas and temporary access roads will be maintained in a sound, reasonably serviceable condition.
2.	Maintenance may require blading and shaping the roadbed, including shoulders and turnouts to remove ruts, washes, and other irregularities that prevent normal runoff from the road surface.
3.	Blading shall restore the road surface without loss of aggregate/gravel surfacing material or natural road base material.
4.	All fallen trees, limbs, or brush in the travel way or road ditch line shall be removed and scattered outside the travel way. Rocks and debris hazards will also be removed from the roadway.
5.	Temporary access routes will not be constructed in landslide prone areas or areas prone to saturation.
6.	Adequate drainage facilities in the form of ditches, culverts, or other conduits will be installed as necessary to maintain temporary access roads. All temporary access and haul roads will have cross drains installed in drainageways.
7.	Existing drainage dips and roadside ditches shall be cleaned and reestablished if needed with the out-slope grade restored to equal or exceed the gradient of the road.
8.	Snow plowing will include full width snow removal to a smooth ice floor by snowplow equipment.
9.	Hazards will be posted as appropriate according to the standards and approval of the road corridor jurisdiction.
10.	Road maintenance activities will be avoided during times in which Endangered Species Act (ESA) listed fish are spawning immediately downstream of disturbance.
11.	Road maintenance activities will be avoided when surface material is saturated.
12.	Hazards, obstacles, and maintenance needs along the entire access route will be reported to the appropriate jurisdiction for coordinated mitigation.
C.	**Temporary Stream Crossings and Bridges**
1.	Existing stream crossings will be preferentially used whenever reasonable, and the number of temporary stream crossings will be minimized.
2.	Temporary bridges and culverts will be installed to allow for equipment and vehicle crossing over perennial streams during construction. Treated wood shall not be used on temporary bridge crossings or in locations in contact with or directly over water.

3.	Vehicles and machinery shall cross streams at right angles to the main channel whenever possible.
4.	After project completion, temporary stream crossings will be obliterated, and banks restored.
5.	Any large wood, topsoil, and native channel material displaced by construction will be stockpiled for use during site restoration at a specifically identified and flagged area.
D.	**Fuel and Equipment Hauling**
1.	The USFS Project Administrator and Valley County Sheriff Dispatch will be notified a minimum of 48 hours in advance of fuel convoys.
2.	Drivers will be experienced in hauling on backcountry roads and will be familiar with the travel routes.
3.	Hauling will be during daylight hours and in acceptable weather.
4.	Pilot and emergency response vehicles will carry appropriate spill containment and first aid equipment.
5.	Fuel will not be hauled on the weekends along Johnson Creek Road.

3. FUGITIVE DUST CONTROL

Unpaved roads, earth disturbance, soil transport, and material piles have potential to increase particulate emissions associated with remediation activities. Table 3-1 consolidates environmental protection measures associated with fugitive dust control for the removal actions to be completed under the ASAOC.

Table 3-1 Dust Control Environmental Protection Practices

1.	Fugitive dust control will be provided during all phases of project implementation.
2.	The weather forecast and meteorological conditions, as well as daily visible emissions checks will be utilized to reduce dust emissions during project implementation.
3.	Proper dust control will be employed along transportation corridors and active construction areas using aquatic safe dust suppression chemicals (typically magnesium chloride, calcium chloride salts, or lignin sulfonate) or water trucks in accordance with applicable road maintenance agreements.
4.	Dust-abatement additives and stabilization chemicals (typically magnesium chloride, calcium chloride salts, or lignin sulfonate) will not be applied within 25 feet of water or a stream channel and will be applied to minimize the likelihood that they will enter streams.
5.	Perpetua will use their existing, future, or temporary water rights in coordination with Idaho Department of Water Resources for dust suppression activities, as appropriate and required.
6.	Further reduce vehicular speeds and routes of travel during dry periods of high dust generation.
7.	Cover loose soil and debris or wet as appropriate to prevent wind generation of dust.
8.	Limit soil disturbance and sequence work elements as practicable to limit open soil. Retain native vegetative cover as much as possible.
9.	All equipment used for the application of water will be equipped with a positive means of shut-off.

4. EROSION AND SEDIMENT CONTROL

Perpetua maintains a Stormwater Pollution Prevention Plan (SWPPP) for the larger Stibnite Gold Project and has adopted a suite of BMPs for erosion and sediment control based on Idaho Department of Environmental Quality's (IDEQ) *2005 Catalog of Stormwater Best Management Practices for Idaho Cities and Counties* (IDEQ BMP Catalog) (IDEQ 2005). This SWPPP covers areas outside of the ASAOC actions. However, the general standards established are relevant to controlling stormwater runoff for ASAOC activities. As such they have been incorporated into this EPP where applicable (**Appendix B**). Table 4-1 summarizes the list of erosion and sediment control BMPs selected from the IDEQ BMP Catalog. Construction and design specifications are described in full in the IDEQ BMP Catalog.

Erosion and sediment controls will be installed prior to earth disturbing activities. These controls will be installed along the perimeter of disturbed areas that may receive stormwater, except where site conditions prevent the use of such controls (in which case, installation will be modified to maximize their use to the extent practicable). Final stabilization of active construction areas will be initiated immediately following construction completion. If conditions exist where it is not possible to initiate permanent stabilization measures within 14 days, Perpetua will retain existing controls and implement temporary stabilization measures as soon as practicable. Interim measures such as mulching will be employed until permanent vegetative (or other) stabilization is achieved.

Maintenance and inspection of erosion and sediment controls will be conducted and documented weekly at a minimum or more frequently as appropriate. Maintenance will include removal of sediment before it accumulates to one-half of the aboveground height of any sediment or erosion control structure. If erosion and sediment controls require maintenance or corrective action to continue operating effectively, all efforts will be made to fix them immediately after discovery and complete such work in a timely manner. When a control must be replaced or repaired, Perpetua will complete the work within seven days, or as soon practicable.

Table 4-1 Erosion and Sediment Control Environmental Protection Practices[1]

IDEQ BMP #	Description of BMP	
1.	Timing of Construction	Schedule and sequence construction work and erosion control applications to occur when the potential for erosion is lowest.
2.	Staging Areas	Collect runoff from staging and storage areas or divert water flow away from such areas.
3.	Preservation of Vegetation	Protect existing vegetation and utilize natural buffer areas.
4.	Clearing Limits	Minimize the total amount of bare soil exposed.
5.	Stabilization of Entrance and Exit	To limit sediment and debris tracking.
6.	Temporary Roads	Measures to prevent erosion and sedimentation on temporary access.
8.	Cover for Materials and Equipment	Partial or total physical enclosure of materials, equipment, or activities to prevent potential pollutant and material loss.
9.	Stockpile Management	Minimize erosion of any stockpiles from stormwater and wind via temporary cover or watering, as necessary. Prevent up-slope stormwater flows from causing erosion of stockpiles (e.g., divert flows around the stockpile). Minimize sediment from stormwater that runs off stockpiles, using sediment controls (e.g., sediment barrier or downslope sediment control).
15.	Mulching	Temporary to reduce erosion, retain moisture and encourage seed germination. Any straw products used on site will be certified weed free.
20.	Topsoiling	Placement of topsoil or other suitable plant growth material over disturbed areas, when practicable, to provide suitable soil medium for vegetative growth.
21.	Seeding	Use of approved seed mix to prevent weed encroachment and encourage vegetative cover.
23.	Planting	Establish rooted vegetation or vegetative shoots in disturbed areas or as screens.
25.	Slope Roughening	Establish a rough soil surface by creating horizontal grooves, furrows, or depressions, or running parallel to the slope contour.
26.	Gradient Terracing	Establish earth embankments or ridge and channel arrangement constructed along the face of a slope at regular intervals.
30.	Rocked Surface or Slope	Created by an arranged layer or pile of rock placed over the soil surface on slopes. Rocked surfaces protect against erosion and dissipate the energy of runoff or surface water flow.
30., 31.	Outlet and Inlet Protection	Install riprap with filter fabric or mesh at inlets and at or below storm drain outfalls to provide filtering and reduce the speed of concentrated stormwater flows, thereby reducing erosion, scouring, and tracking.

IDEQ BMP #	Description of BMP	
33.	Temporary Stream Crossing	Provides a means for construction vehicles to cross streams or watercourses without moving sediment to streams, without damaging the streambed or channel, and without causing flooding.
35., 36.	Fiber Rolls and Silt Fencing	Assist in sediment control by retaining some of the eroded soil particles and slowing the runoff velocity to allow particle settling.
37.	Vegetative Buffers	A gently sloping area of vegetative cover that runoff water flows through before entering a stream, or other conveyance.
38.	Sediment Traps	A dam or basin used to collect, trap, and store sediment produced by construction activities, or as a flow detention facility for reducing peak runoff rates.
40.	Temporary Swale	Excavated drainage way designed to prevent runoff from entering disturbed areas by intercepting and diverting it to a stabilized outlet, or to intercept water and divert it to a sediment-trapping device.
41.	Earthen Dike	A temporary berm or ridge of compacted soil located in a manner to channel water to a desired location.
43.	Temporary Berms	A ridge of compacted soil, compost, or sandbags which intercepts and diverts runoff from small construction areas.
46.	Dewatering	Reduce, remove or temporarily displace water from watercourses, excavations, and other collection areas.

[1]Derived from IDEQ's *Catalog of Stormwater Best Management Practices* (IDEQ 2005).

5. WASTE MANAGEMENT

In order to effectively manage waste during implementation of ASAOC actions, trash and other miscellaneous inert (non-hazardous) garbage will be collected in bins onsite. Waste will be transported to Donnelly, Idaho where it is collected by the local waste hauler and transported to the Valley County Landfill. Used oils, solvents, grease, and antifreeze will be handled separately from normal trash and garbage. Waste management BMPs are summarized in Table 5-1.

An on-site workcamp will be used during implementation of the ASAOC actions during the snow free months (Figure 5-1). Perpetua also retains a temporary housing trailer that includes a bath house. This camp is located on private property and has a septic drainfield for all toilets, showers, and household water. These facilities will be maintained and staffed by Perpetua, including a camp manager.

If any event occurs during performance of the ASAOC activities that causes or threatens to cause a release of waste material on, at, or from the Site that either constitutes an emergency situation or that may present an immediate threat to public health or welfare or the environment, all appropriate actions will be immediately taken to prevent, abate, or minimize such release or threat of release. These actions will be taken in accordance with the applicable provisions of the ASAOC, including, but not limited to, the Health and Safety Plan (EPA and USFS 2021).

Table 5-1 Environmental Protection Practices for Waste Management

1.	Locate and maintain construction work area and access corridors in a clean, safe, and sanitary condition at all times.
2.	Garbage and trash will be removed regularly and disposed of in an approved waste disposal facility. General clean-up operations will be conducted daily.
3.	Adequate trash receptacles will be provided throughout the work site. All dumpsters will have lids that will be kept firmly closed when not in use.
4.	All facilities will follow local public health standards and regulations.
5.	Any on-site portable toilets will be located away from surface water bodies and will be serviced by a state licensed sewage waste disposal contractor. No garbage will be burned.
6.	At project completion, all equipment, supplies, and refuse will be removed from the project site and disposed of according to established solid and liquid waste management practices and applicable local, state, and federal law.
7.	No toxic or hazardous substances will be used on site, except for standard petroleum fuel and lubricant products (diesel, gasoline, grease, and hydraulic oils), and “over-the- counter” retail products. After completing operations, all empty fuel and lubricant containers will be removed from the operations area and transported and disposed in accordance with local, state, and federal requirements.

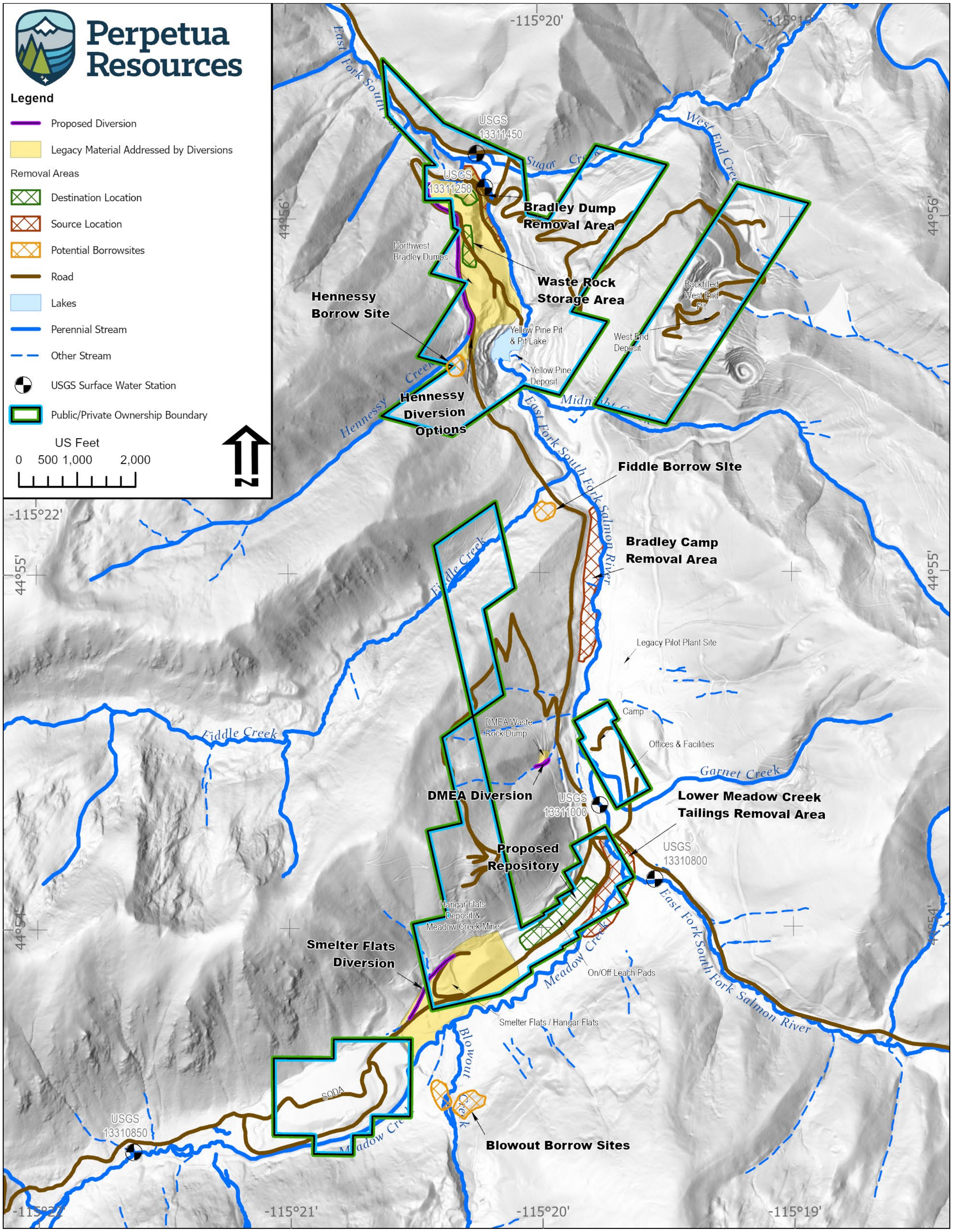

Figure 5-1 Map of ASAOC Locations

6. FUEL HANDLING AND SPILL PREVENTION

Perpetua maintains a Spill Prevention, Control and Countermeasure Plan (SPCC) for the larger Stibnite Gold Project that includes all contact information, reporting requirements and response criteria. The SPCC is included in Appendix C. ASAOC actions will be supported with fuel from the Perpetua fuel site. The Stibnite Project fuel infrastructure is located near the core shed/maintenance shop (Figure 5-1) and includes a primary fuel storage area and a secondary fuel storage area. The primary fuel storage area includes 49,000-gallon (aggregate) diesel fuel storage and has a containment system comprised of a concrete floor that is sloped toward a plugged drain near the center. The sloped design collects any spilled fuel and water, to be disposed of offsite. The containment area is covered with a pole-supported roof to minimize precipitation accumulation within containment.

A secondary fuel storage area is located immediately west of the Shop and contains two aboveground storage tanks (AST) consisting of two 2,500-gallon, double-walled gasoline tanks within tertiary containment, a 100-gallon premium gasoline AST and three 55-gallon drums with premium gasoline within two clamshell containments. Any additional fuel will be stored in sealed 55-gallon steel drums, approved double-walled fuel tanks, or in approved single-walled tanks within secondary containment. Fuel will be managed, tanks would be inspected, and any oil release would be responded to in accordance with the SPCC plan.

The shop building houses two small, double-walled, used-oil ASTs. The used oil is burned in the building furnace to provide heat. In addition, Jet A fuel (5,000 gallons) and diesel (2,500 gallons) is stored in double walled tanks within tertiary containment adjacent to the helicopter hangar.

If any event occurs during performance of the ASAOC activities that causes or threatens to cause a release of fuel on, at, or from the Site that either constitutes an emergency situation or that may present an immediate threat to public health or welfare or the environment, all appropriate actions will be immediately taken to prevent, abate, or minimize such release or threat of release. These actions will be taken in accordance with the applicable provisions of the ASAOC, including, but not limited to, the Health and Safety Plan (EPA and USFS 2021). Specific requirements for spill prevention, control, and response as they relate to pollution control are summarized in Table 6-1.

Table 6-1 Environmental Protection Practices for Fuel Handling and Spill Prevention[1]

A.	**Minimize Potential Pollutant Discharge**
1.	A copy of the SPCC plan will be kept at an appropriate onsite facility. Staff handling fuel or petroleum products will be trained to successfully implement the SPCC plan.
2.	Vehicles and equipment will be inspected daily for fluid leaks before leaving construction staging and material storage areas.
3.	Fuel will be properly stored, labeled, and inventoried.
4.	Secondary containment, spill kits, or other equivalent measures will be used for fueling operations.
5.	Fueling sources and facilities will be located away from surface waters and drainageways.
6.	Fuel, equipment, and fueling activities will be located so that potential leaks and spills are able to be contained or diverted before discharge.
7.	All spills will be cleaned up, documented, or reported immediately as appropriate.
8.	Used oil and oily material recovered from spill cleanup operations will be disposed of in a manner approved by IDEQ, and in compliance with applicable EPA regulations.
9.	Pumps used adjacent to water shall use spill containment systems.
10.	Safety Data Sheets (SDS) for all products will be posted and available on site.
11.	All fuel containers will be marked with contents, owner's name, and contact information.
B.	**Equipment Staging and Material Storage**
1.	Transport of equipment is generally done before mid-March or after June when road conditions allow. As needed, end of season equipment mobilization will take place in late November or early December.

2.	Equipment will be stored at the site laydown yards and adjacent to the core shack on private property whenever possible. Some equipment is already on site from previously permitted exploration activities.
3.	Equipment will be maintained in good condition and inspected regularly for leaks and damage.
4.	All equipment brought on-site will be in proper operating order, used in the manner it is designed for, and maintained as such.
5.	Equipment will be cleaned of dirt and mud prior to demobilization or transport on public paved roadways.
6.	Vehicle and equipment cleaning, maintenance, refueling, and fuel storage will be conducted at least 150 feet away from any natural water body.
7.	Materials will be stored in accordance with the manufacturer's instructions when applicable. Regular inspection of material storage areas will be conducted for signs of liquid leakage, or tears in protective packaging for other stored materials.
8.	All storage and staging areas will be kept clean and free of accumulated waste.
C. Primary Fuel Storage Area and Fueling	
1.	All petroleum products will be transported in accordance with state and federal Department of Transportation (DOT) regulations and handled and stored as per applicable state and federal petroleum product storage and handling laws and regulations.
2.	Fuel will be stored in identified storage areas, in sealed 55-gallon steel drums, approved double-walled fuel tanks, or in approved single-walled tanks within secondary containment.
3.	Fuel delivery vehicles will drive completely into containment areas, and all refueling operations will be completed therein.
4.	No sources of flame or potential sparks will be in the vicinity when fueling.
5.	Hoses will be maintained in a position to prevent spillage.
6.	All hoses and the delivery trucks will be inspected regularly.
7.	A detailed log of fueling activities will be kept up to date.
8.	Fuel containment sites, engines and other equipment with fuel or lubricants will be periodically checked for leakage or spillage and in accordance with the SPCC plan
9.	All bulk fuel storage will be placed outside of the floodplain and high-water mark of surface waters.
10.	A standard spill prevention kit, and fire kit will be stored at the re-fueling site and would be readily available during off-loading of fuel from the fuel truck or during refueling operations.
11.	Regular inspections will be performed for all hazardous material and fuel storage areas.
D. Spill Response	
1.	All fuel transport drivers will be required to have spill response, safety, and resource awareness training.
2.	The operator will immediately report any fuel, oil, or chemical discharges or spills greater than 25 gallons on land, or any spill directly in a stream as required by applicable federal and state regulations.
3.	In the event of a spill, all personnel will be accounted for to ensure their safety.
4.	Appropriate cleanup with be initiated immediately according to the parameters in the SPCC and other authorities.
5.	Two or more stored spill containment/response caches will be placed along the fuel delivery route.
6.	Report all spills as required to appropriate authorities.

[1]Derived primarily from *Stibnite Gold Exploration Project, Spill Prevention, Control, and Countermeasures Plan*, (Perpetua 2019).

7. STOCKPILES AND BORROW SOURCES

Material stockpiles and borrow sources will be required for the removal actions to support project objectives and reclamation of work areas. Stockpiling will be utilized to preserve native topsoil and vegetation wherever possible, and additional construction material stockpiles will be created as borrow materials are sorted (screened) to segregate various silt/sand, gravel, cobble, and boulder fractions for later use. General BMPs for borrow sources and stockpiles are summarized in Table 7-1. Perpetua has developed a Borrow Source Development Plan for the ASAOC actions. The primary objective of this borrow source investigation is to find suitable material that meets geotechnical specifications and agreed upon chemical concentration criteria for use. Perpetua has identified four proposed borrow sources that likely do not contain mineralization. It is estimated Perpetua will require approximately 50,000 cubic yards of borrow material for the Phase 1 removal actions.

Table 7-1 Environmental Protection Practices for Borrow Sources and Stockpiles

A. Stockpiles	
1.	Keep stockpiled soil and vegetative material that is to be reused clean by clearly isolating from other potential contaminant sources.
2.	Direct surface water away from stockpiles to prevent erosion or deterioration of materials.
3.	Maintain dust control on stockpiles as necessary.
4.	Prevent weeds from establishing on stockpiles. Treat weed occurrences on and near stockpiles as appropriate.
5.	BMPs (straw wattles, etc.) will be placed around stockpiles to prevent sediment transport during storm events. If soil stockpiles will be stored for more than one season they will be seeded or mulched to prevent weed encroachment.
B. Borrow Sources	
1.	Work will be performed in designated borrow areas only. Land disturbance will be minimized to the greatest extent possible. Vegetation located outside of the construction limits will not be disturbed.
2.	Topsoil and any brush removed will be stockpiled separate from the excavated material and used in site reclamation. Tree removal will be kept to the minimum amount necessary for safe access and operation. Cut trees and root wads will be retained on site for reclamation.
3.	Standard reclamation practices will be followed, including segregating and stockpiling topsoil, implementing stormwater and sediment BMPs, backfilling and placing topsoil, and revegetation. Any areas leveled for test pits or temporary access will be re-contoured and re-seeded.
4.	Borrow areas will be managed to prevent and/or limit sediment from entering surface water or land adjacent to the site.
5.	Earthwork will be executed in a manner to minimize the exposure and duration of exposure of unprotected soils.
6.	Protect side slopes and backslopes as soon as rough grading is completed by diverting surface runoff and/or establishing runoff drop structures and channels, to prevent erosion of said slopes.
7.	All excavations will be free of overhangs, and the sidewalls will be kept free of loose material.

8. RESTORATION AND REVEGETATION

All disturbed areas and borrow sources will be restored and revegetated as soon as practicable following construction. Standard restoration and revegetation practices will be followed, including segregating and stockpiling topsoil, implementing stormwater and sediment BMPs, backfilling and placing topsoil, and revegetating. Table 8-1 summarizes environmental protection practices for restoration and revegetation.

Table 8-1 Environmental Protection Practices for Restoration and Revegetation

1.	Initiate vegetative stabilization as soon as conditions allow. Establish a goal of 70% cover within three years of planting.
2.	Reclamation seeding will be done with native seed mixtures appropriate for the elevation and habitat. Prior to installation, types, locations, and amounts of seed will be approved by the Forest Service.
3.	Topsoil and any brush removed will be stockpiled separate from fill material and used in reclamation.
4.	For any borrow source, standard reclamation practices will be followed, including segregating and stockpiling topsoil, implementing stormwater and sediment BMPs, backfilling and placing topsoil, and revegetation.
5.	To minimize the risk of noxious weed infestations or spread of weed seeds, equipment will be inspected and cleaned prior to mobilizing onto the Payette National Forest or Project Area.
6.	All access routes shall be restored to their original condition and prepped for seeding by scarifying the surface at the end of construction.
7.	Project areas will be inspected prior to project-related activities and treated if they are found to be weed-infested. Herbicide use, where prescribed, will be in accordance with the *South Fork Salmon River Sub Basin Noxious and Invasive Weed Management Program* (USFS 2007).
8.	Only certified weed free straw, wattles or bales will be used on site.
9.	Soil stockpiles will be kept in a clean and orderly manner. Water may be used during dry periods to prevent soil loss to dust. Seeding or mulching may be necessary to prevent weeds. Perimeter sediment controls may need to be installed.

9. WILDLAND FIRE PREVENTION

The Site is located in a wildland fire prone area. As such, care and diligence will be taken during dry conditions and the traditionally recognized wildland fire season. Table 9-1 summarizes Environmental Protection Practices to prevent wildland fire resulting from project activities and reduce wildland fire risk from an outside source.

Table 9-1 Environmental Protection Practices to Prevent Wildland Fire

1.	Equipment that could potentially come into contact with dry vegetation will be required to have functional spark arrestors.
2.	Fire suppression equipment will be kept at each work site and in vehicles as appropriate. This includes shovels, axes, buckets, and fire extinguishers.
3.	All activities will be conducted in accordance with State of Idaho fire protection procedures (as outlined in IDAPA 20.04.01), local Valley County Fire District regulations, and Forest Service rules and regulations and 36 CFR 228.11.
4.	Several fire-response kits will be spaced strategically around the project area in case of fire.
5.	On-site staff will monitor local and on-site fire conditions and maintain contact with local area fire officials to ensure appropriate fire management procedures are followed in the event of implementation of fire restrictions or woodland use restrictions (e.g., “Red Flag Warnings”).
6.	Any fire occurrence will be reported immediately to the local fire management units.
7.	The Site will be kept clean and clear of debris.

10. FISHERIES AND AQUATIC RESOURCES

Four federally listed or Forest Service sensitive fish species and their critical habitats are associated with the Stibnite area: Chinook salmon (*Oncorhynchus tshawytscha*), steelhead trout (*Oncorhynchus mykiss*), bull trout (*Salvelinus confluentus*), and westslope cutthroat trout (*Oncorhynchus clarkii lewisi*). Chinook salmon, steelhead, and bull trout are federally listed as threatened under the Endangered Species Act (ESA), and westslope cutthroat trout is a Forest Service sensitive species. All actions conducted under this ASAOC have incorporated resource protections and management considerations specific to current regulatory guidance, species specific design criteria, and proven BMPs for fisheries resources to preclude impacts to fisheries and aquatic species and habitat. This includes the following guidance:

- Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Payette National Forest, December 2020.
- National Marine Fisheries Service (NMFS), 2019. Re-initiation of the Endangered Species Act Section 7(a)(2) Programmatic Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation Habitat Restoration Projects in the Salmon River Basin (HUC 170602), Clearwater River Basin (HUC 170603), Hells Canyon Subbasin (HUC 17060101), and Lower Snake-Asotin Subbasin (HUC 17060103), Idaho NMFS Consultation Number: WCR-2018-9898.
- Formal Section 7 programmatic consultation on Bonneville Power Association’s (BPAs) Columbia River Basin Habitat Improvement Program, 2014.
- Stibnite Gold Project Stream Design Report (Rio ASE, 2021).
- U.S. Bureau of Reclamation’s Large Woody Materials Risked-Based Design Guidelines, September 2014.

During the TCRA removal actions, resource protections will be established, prior to the onset of disturbance, to protect aquatic habitat and minimize sediment introduction during instream work and work adjacent to streams. Work in these areas will be conducted during dry conditions (summer and fall season), utilize structural controls, include turbidity monitoring for adaptive project management, and incorporate native plants in reclamation plans. Fisheries and other aquatic resource protection measures are listed in Table 10-1.

Table 10-1 Environmental Protection Practices to Protect Fisheries and Aquatic Resources

A.	**Fisheries and Aquatic Resources**
1.	Environmental protection practices outlined in applicable programmatic or project-specific biological assessments for fisheries and aquatic resources will be incorporated into all phases of ASAOC action implementation, as appropriate.
2.	Work requiring equipment to operate partly or wholly below the ordinary high-water line will be completed during the approved in-water work window. Equipment must be thoroughly cleaned before entering the water.
3.	In fish-bearing waters, intake hoses will be screened with the most appropriate mesh size (generally 3/32 of an inch), or as determined through coordination with NOAA Fisheries and/or USFWS. Water supply points, service areas, and other needs for road and facility construction projects are to be identified before implementation to avoid impacts to, soil, water and riparian resources and occupied special status plant habitat.
4.	Fish passage will be provided at all proposed and reconstructed stream crossings of existing and potential fish-bearing streams.
5.	Potential water sources will be surveyed by Perpetua in coordination with the Forest Service for Columbia spotted frog egg masses and other amphibians after ice melt and avoid disturbing any water sources with identified egg masses or other species. Exceptions: If egg masses are found at a water source essential for project activities, the egg masses would be relocated in coordination with the USFS.
6.	Any work area within the wetted channel will be isolated from the active stream whenever ESA-listed fish are reasonably certain to be present, or if the work area is less than 300 feet upstream from known spawning habitats.
7.	Work area isolation and fish salvage activities will comply with the in-water work window.
8.	Work area isolation and fish capture activities will occur during periods of the coolest air and water temperatures possible, normally early in the morning versus late in the day, and during conditions appropriate to minimize stress and death of species present.
9.	Plume or turbidity monitoring may be required both upstream and downstream of instream work.

11. CULTURAL RESOURCES

Archaeological surveys have been completed in the general project area to support SGP NEPA permitting activities. Upon completion of work plans and 30% designs for the removal action, Perpetua or the USFS On-Scene Coordinator (OSC) will coordinate with the USFS archaeologist or heritage program manager to determine if existing NEPA cultural survey coverage adequately covers the TCRA work area, and if cultural resources have been identified within 200 feet of TCRA work areas or access roads. If existing coverage is determined to be inadequate, USFS and/or Perpetua will arrange for additional on-the-ground archaeological surveys to be completed prior to initiation of construction or ground disturbing activities.

If previously undiscovered cultural resources (historic or prehistoric objects, artifacts, or sites) are encountered or exposed as a result of construction operations, operations will immediately cease within 100 feet of the discovery to secure the location. The agency OSCs will be notified, and operations would not proceed in that area until approval is received from USFS archaeologist and/or agency OSC.

These provisions shall not apply to mining-related historical infrastructure and mining-related discarded materials likely to be present in the work areas, including historical building foundations, tailings dams, bottles, cement pads, plumbing pipes, track, rails, electrical wiring, barrels, shingles, bedframes, papers, old shoes, and other 20th century historical materials.

12. OTHER RESOURCE SPECIFIC PROTECTION PRACTICES

Recent permitting and design for the larger Stibnite Gold Project proposed by Perpetua has resulted in an increased understanding of baseline and existing condition for natural resources associated with the Site. Standards and guidelines in the Payette National Forest Land Resource Management Plans (RMP; USFS 2010) that are designed to reduce or prevent undesirable impacts resulting from proposed management activities are incorporated into all ASAOC actions. Many of the Environmental Protection Practices presented in previous sections are intended to limit or mitigate impacts to multiple resources. Resource specific mitigations and design features are emphasized in individual Work Plans and tailored to the individual project location, engineering design, surface water features, and site-specific conditions.

The Statement of Work (SOW) for the ASAOC requires that a biological assessment be completed that characterizes baseline conditions of existing habitat in and around Time Critical Response Action (TCRA) areas; addresses potential project impacts that the projects may have on threatened or endangered species, their habitat, and their food stocks; and describes best management practices and conservation measures designed to avoid or minimize any negative impacts. The SOW further requires that a Clean Water Act Section 404 analysis memorandum be prepared, if the recommended removal action alternatives will impact jurisdictional wetlands. The memorandum shall document the information gathered regarding practicability and cost, long and short-term effects from all proposed alternatives, minimization of adverse effects, and an analysis of the need for any mitigation. Environmental protection practices outlined in the project specific biological assessment and wetland memorandum are incorporated into all phases of ASAOC action implementation.

Table 12-1 lists overarching resource specific environmental protection practices and incorporates best management practices and mitigation features by reference.

Table 12-1 Other Resource Specific Environmental Protection Practices

A. Wildlife	
1.	Environmental protection practices outlined in the project specific biological assessment for terrestrial species will be incorporated into all phases of ASAOC action implementation, as appropriate.
2.	The appropriate state and federal wildlife managers will be notified of occupied Endangered Species Act or sensitive species nests, dens or critical habitat encountered during project implementation. Sightings of listed or sensitive wildlife species will be reported to the USFS.
3.	Any adverse wildlife encounters will be reported to the appropriate state and federal wildlife managers.
4.	Calving and fawning areas will be protected from project-related disturbance during big game calving or fawning season.
5.	To prevent inadvertent entrapment of common and special-status wildlife during construction, all excavated, steep-walled holes or trenches more than two feet deep will be covered with tarp, plywood, or similar materials at the close of each working day to prevent animals from being trapped.
6.	Boreal and great gray owl and northern goshawk sightings or nests will be reported to the USFS for appropriate follow up.
B. Wetlands and Riparian Areas	
1.	Environmental protection practices outlined in the project specific wetland memorandum will be incorporated into all phases of ASAOC action implementation, as appropriate.
2.	Wetland and stream reclamation areas with be restored with native plant species as appropriate.
3.	Existing access routes will be preferentially used whenever reasonable, and the number and length of temporary access roads and paths through riparian areas, wetlands and floodplains will be minimized.
4.	Wetlands and riparian areas outside of the work limits will be protected wherever access roads traverse through these features and will be restored to their original grade and condition. Protection measures will include stripping and stockpiling wetland vegetation for subsequent reclamation, protective mats, and wood chips or quarry spalls underlain with geotextile fabric will be installed. All protective materials will be removed at project completion.
5.	The removal of riparian vegetation during construction of temporary access roads will be minimized. When temporary vegetation removal is required, vegetation will be cut at ground level (not grubbed).
C. Weeds and Invasive Species	
1.	Project areas will be inspected for noxious and invasive species prior to the onset of the project. Weeds will be avoided or treated as appropriate. Equipment will be inspected prior to entering the project area.
2.	Project areas will be inspected for special status species plants prior to the onset of the project. Any protected plants encountered will be reported to the USFS and consideration will be given to preserve or move these individuals.
3.	Seeds and plants used for seedings and plantings in revegetation projects will originate from genetically local sources of native species.

4. When feasible, growth media and seedbank materials from wetlands and riparian disturbance areas will be salvaged and stockpiled for subsequent restoration.
5. Borrow sites will be inspected for weeds prior to use.
6. Contractors will be required to pressure wash and remove all dirt, grease, oil, fuel, vegetation and weed seeds before bringing equipment on site to limit introduction of noxious weeds, aquatic invasive species, and pollutants to the site.
7. Watercraft, waders, boots, and any other gear to be used in or near water will be inspected for aquatic invasive species. Wading boots with felt soles are not to be used due to their propensity for aiding in the transfer of invasive species unless approved decontamination procedures have been used.
D. Soil
1. For borrow sources and all areas of temporary disturbance, standard reclamation practices will be followed, including segregating and stockpiling topsoil, implementing stormwater and sediment BMPs, backfilling and placing topsoil, and revegetating.
2. To minimize material loss and sediment runoff from the temporary roads and roadbeds, water bars, silt fencing, certified weed-free wattles, and/or weed-free straw bales will be installed in strategic downslope areas and in Riparian Conservation Areas (RCAs).
E. Air Quality
1. When practicable, pumps, generators, and engines will be turned off when not in use to avoid unnecessary noise generation and reduce energy consumption and emissions.
F. Night Sky and Noise
1. Work will be conducted during daylight hours whenever possible.
2. Whisper Quiet light plants with light shields will be used to mitigate visual impacts from night necessary operations.
3. Buildings and equipment and drill rigs will have limited external lighting and will employ noise-minimizing practices. Light shields will be placed over outside lights, confining light to the immediate area in order to further limit visual impacts.

13. SITE SPECIFIC PROTECTIONS – STREAM DIVERSIONS

Table 13-1 Site Specific Protection Measure Summary - Stream Diversions

A. General Consideration
1. All permanent diversions will be constructed to accommodate the 100-year flood event.
2. Any material not used in restoration, and not native to the floodplain, will be disposed of outside the floodplain.
3. Any large wood, topsoil, and native channel material displaced by construction will be stockpiled for use during site restoration at a specifically identified and flagged area.
4. Natural materials used for implementation of aquatic restoration, such as large wood, gravel, and boulders, may be staged within 150 feet of watercourses if clearly indicated in the plans that area is for natural materials only.
5. If there is a potential for eroded sediment to enter the stream, sediment barriers will be installed and maintained for the duration of project implementation.
B. Temporary Access Roads
1. All temporary access roads will be depicted in the design package. The Contractor may not deviate from these locations without prior approval.
2. Establish access road for access from public roads to the work area of a width and load-bearing capacity to provide unimpeded traffic for construction purposes.
C. Work Area Isolation and Cofferdams
1. The Contractor shall place temporary cofferdams between the actively flowing river surface water and all active work areas. The Contractor may place temporary cofferdams at additional locations to achieve required water quality standards, or simplify construction as determined by the Contractor.
2. Fill material for bulk bags or “super sacks”, if used, shall be clean, washed, and rounded material similar in gradation to the existing channel substrate, and not contain fines. Material must be approved before use.
3. Cofferdams and diversion dams must be built in a manner to meet turbidity limits as defined in the project Specifications. Use of gravel and soil to build a pushup type cofferdam or flow diversion dam are acceptable at locations not connected to surface water flow but will not be allowed in the actively flowing channel.
D. Dewatering and Pumping

1.	Dewatering will occur at a rate slow enough to allow species to naturally migrate out of the work area.
2.	Where a gravity feed diversion is not possible, a pump may be used. Pumps will be installed and operated to avoid repetitive dewatering and rewatering.
3.	When fish are present, pumps will be screened in accordance with NMFS fish screen criteria.
4.	Dissipation of flow energy at the bypass outflow will be provided to prevent damage to the stream channel and riparian vegetation.
5.	Seepage water will be pumped to a temporary storage and treatment site or into upland areas to allow water to percolate through soil and vegetation prior to reentering the stream channel.
E.	**Staged Rewatering Plan**
1.	When reintroducing water to dewatered areas and newly constructed channels, a staged rewatering plan will be applied. The following will be applied to all rewatering efforts. Complex rewatering efforts may require additional notes or a dedicated sheet in the construction details. • Turbidity monitoring protocol will be applied to rewatering efforts. • Pre-wash the area before rewatering. Turbid wash water will be detained and pumped to the floodplain or sediment capture areas rather than discharging to fish-bearing streams. • Install seine nets at upstream end to prevent fish from moving downstream until 2/3 of total flow is restored to the channel. • Starting in early morning introduce 1/3 of new channel flow over period of 1 to 2 hours. • Introduce second third of flow over next 1 to 2 hours and begin fish salvage of bypass channel if fish are present. • Remove upstream seine nets once 2/3 flow in rewatered channel and downstream turbidity is within acceptable range (less than 40 NTU or less than 10% background). • Introduce final third of flow once fish salvage efforts are complete and downstream turbidity verified to be within acceptable range. • Install plug to block flow into old channel or bypass. Remove any remaining seine nets.
F.	**Turbidity Monitoring**
1.	Record the reading, location, and time for the background reading approximately 100 feet upstream of the project area using a recently calibrated turbidimeter or via visual observation.
2.	Record the turbidity reading, location, and time at the measurement compliance location point. • 50 feet downstream for streams less than 30 feet wide. • 100 feet downstream for streams between 30 and 100 feet wide. • 200 feet downstream for streams greater than 100 feet wide.
3.	Turbidity will be measured (background location and compliance points) every 4 hours while work is being implemented.
4.	If exceedances occur for more than two consecutive monitoring intervals (after 8 hours), the activity will stop until the turbidity level returns to background. The OSCs will be notified of all exceedances and corrective actions at project completion.
5.	If turbidity controls (coffer dams, wattles, fencing, etc.) are determined ineffective, crews will be mobilized to modify, as necessary. Occurrences will be documented in the project daily reports.

14. SITE SPECIFIC PROTECTIONS – BRADLEY MAN CAMPS

Table 14-1 Site Specific Protection Measure Summary - Bradley Man Camps Removal

A.	**Repository BMPs**
1.	The tailings and waste rock will be placed in lifts, with the lift height sufficient to achieve design compaction. Maximum lift height specifications are set based on maximum anticipated particle size in the fill. Max lift heights for soils with cobbles is typically twice the maximum particle size (lift height = 2 * max particle size). As the waste dumps are likely to contain

	material exceeding 18", larger lift heights are likely warranted. One foot lift height may be appropriate for tailings depending on compaction specifications.
2.	After material placement, spreading, and leveling to the appropriate lift thickness, tailings and waste rock will be uniformly compacted.
3.	Work will be executed in a manner to minimize the exposure and duration of exposure unprotected waste rock or tailings.
4.	A waste placement plan will be developed in the design and construction planning phases once final time critical removal actions are selected, as it must coordinate activities between multiple removal projects. Perpetua proposes to take advantage of atmospheric drying during the hot and dry construction period on site and has included additional methodologies to enhance drying in the description of the removal action. The field investigation will collect data to assess the effectiveness of these proposals.
5.	Maximum final side slopes will not exceed 3H:1V
6.	Minimum final slope will be 3% to minimize ponding potential.
7.	Standard stormwater management, sediment control, and dust control BMPs will apply to repository construction.
8.	The repository cover will be graded to drain and minimize ponding to reduce infiltration.
9.	Traffic associated with the repository will yield on public roadways. Flaggers, signage and barricades will be used at the site entrance as necessary for safety.
10.	Water sprinkling will be conducted as needed to control dust.
B. Haul Traffic	
1.	Caution signs and directional signs will be installed during hauling operations. Night operations, if required, will include lighting as necessary.
2.	The haul route will be inspected and maintained regularly for surface integrity, erosion and sediment control and dust suppression.
C. Stream Protection Adjacent to Work Area	
1.	Roll out protection will be applied in work areas immediately adjacent to the East Fork South Fork Salmon River.
2.	Equipment will not be allowed to enter the water column.
D. Dewatering and Pumping	
1.	Dewatering will utilize land application within the existing work phases as necessary.
2.	Wet material will be staged within the work area for drying prior to being hauled to the Repository.

15. SITE SPECIFIC PROTECTIONS – TAILINGS REMOVAL

Table 15-1 Site Specific Protection Measure Summary – Tailings Removal

A. Temporary Access Roads	
1.	All temporary access roads will be depicted in the design package. The Contractor may not deviate from these locations without prior approval.
2.	Establish access road for access from public roads to the work area of a width and load-bearing capacity to provide unimpeded traffic for construction purposes.
B. Work Area Isolation and Cofferdams	
3.	The Contractor shall place temporary cofferdams between the actively flowing river surface water and all active work areas. The Contractor may place temporary cofferdams at additional locations to achieve required water quality standards, or simplify construction as determined by the Contractor.

4. Fill material for bulk bags or "super sacks", if used, shall be clean, washed, and rounded material similar in gradation to the existing channel substrate, and not contain fines. Material must be approved by the Contracting Officer and clearly defined in the Cofferdam and Flow Diversion Plan submittal.
5. Cofferdams and diversion dams must be built in a manner to meet turbidity limits as defined in the project Specifications. Use of gravel and soil to build a pushup type cofferdam or flow diversion dam are acceptable at locations not connected to surface water flow but will not be allowed in the actively flowing channel.
C. Fish Salvage
1. Fish salvage activities is expected to be completed by project partners (IDFG or third-party) and will not be the responsibility of the Contractor.
2. Monitoring and recording will take place for duration of salvage. 3. Salvage activities should take place during conditions to minimize stress to fish species, typically periods of the coolest air and water temperatures which occur in the morning versus late in the day.
4. Salvage operations will follow the ordering, methodologies, and conservation measures specified below: • Slowly reduce water from the work area to allow some fish to leave volitionally. • Block nets will be installed at upstream and downstream locations and maintained in a secured position to exclude fish from entering the project area. • Block nets will be secured to the stream channel bed and banks until fish capture and transport activities are complete. Block nets may be left in place for the duration of the project to exclude fish if passage requirements are met. • Nets will be monitored hourly during in-stream disturbance. • If block nets remain in place more than one day, the nets will be monitored at least daily to ensure they are secured and free of organic accumulation. If bull trout are present, nets are to be checked every 4 hours for fish impingement. • Capture fish through seining and relocate to streams. • While dewatering, any remaining fish will be collected by hand or dip nets. • Seines with a mesh size to ensure capture of the residing ESA-listed fish will be used. • Minnow traps will be left in place overnight and used in conjunction with seining. • Electrofish to capture and relocate fish not caught during seining per electrofishing conservation measures. • Continue to slowly dewater stream reach. • Collect any remaining fish in cold-water buckets and relocate to the stream. • Limit the time fish are in a transport bucket. • Minimize predation by transporting comparable sizes of fish in buckets. • Bucket water to be changed every 15 minutes or aerated. • Buckets will be kept in shaded areas or covered. • Dead fish will not be stored in transport buckets but will be left on the stream bank to avoid mortality counting errors.

5. Salvage guidelines for bull trout, mussels (possible but not anticipated), and other native fish are as follows.

- Conduct site survey to estimate salvage numbers.
- Pre-select site(s) for release and/or mussel bed relocation.
- Salvage of bull trout will not take place when water temperatures exceed 15 degrees Celsius.
- If drawdown lasts less than 48 hours, salvage of mussels may not be necessary if temperatures support survival in sediments.
- Salvage mussels by hand, locating by snorkeling or wading.
- Salvage bony fish with nets or electrofishing.
- Regularly inspect dewatered site in case mussels may become visible.
- Mussels may be transferred in coolers.
- Mussels will be placed individually to ensure ability to burrow into new habitat.

D. Dewatering and Pumping

1. Dewatering will occur at a rate slow enough to allow species to naturally migrate out of the work area.
2. Where a gravity feed diversion is not possible, a pump may be used. Pumps will be installed and operated to avoid repetitive dewatering and rewatering.
3. When fish are present, pumps will be screened in accordance with NMFS fish screen criteria.
4. Dissipation of flow energy at the bypass outflow will be provided to prevent damage to the stream channel and riparian vegetation.
5. Seepage water will be pumped to a temporary storage and treatment site or into upland areas to allow water to percolate through soil and vegetation prior to reentering the stream channel.

E. Staged Rewatering Plan

1. When reintroducing water to dewatered areas and newly constructed channels, a staged rewatering plan will be applied. The following will be applied to all rewatering efforts. Complex rewatering efforts may require additional notes or a dedicated sheet in the construction details.

- Turbidity monitoring protocol will be applied to rewatering efforts.
- Pre-wash the area before rewatering. Turbid wash water will be detained and pumped to the floodplain or sediment capture areas rather than discharging to fish-bearing streams.
- Install seine nets at upstream end to prevent fish from moving downstream until 2/3 of total flow is restored to the channel.
- Starting in early morning introduce 1/3 of new channel flow over period of 1 to 2 hours.
- Introduce second third of flow over next 1 to 2 hours and begin fish salvage of bypass channel if fish are present.
- Remove upstream seine nets once 2/3 of flow is in rewatered channel and downstream turbidity is within acceptable range (less than 40 NTU or less than 10% background).
- Introduce final third of flow once fish salvage efforts are complete and downstream turbidity verified to be within acceptable range.
- Install plug to block flow into old channel or bypass. Remove any remaining seine nets.

F. Turbidity Monitoring

1. Record the reading, location, and time for the background reading approximately 100 feet upstream of the project area using a recently calibrated turbidimeter or via visual observation.

2.	Record the turbidity reading, location, and time at the measurement compliance location point. • 50 feet downstream for streams less than 30 feet wide. • 100 feet downstream for streams between 30 and 100 feet wide. • 200 feet downstream for streams greater than 100 feet wide.
3.	Turbidity will be measured (background location and compliance points) every 4 hours while work is being implemented.
4.	If there is a visible difference between a compliance point and the background, the exceedance will be noted in the project completion form (PCF). Adjustments or corrective measures will be taken to reduce turbidity.
5.	If turbidity controls (coffer dams, waddles, fencing, etc.) are determined ineffective, crews will be mobilized to modify, as necessary. Occurrences will be documented in the project construction report.

16. ENVIRONMENTAL STANDARD OPERATING PROCEDURES

Perpetua has developed a series of environmental standard operating procedures (ESOPs) and associated plans that apply to operations at the Site. Copies of the following ESOPs and plans will be retained on site for the duration of the project:

ESOP-001	Spill Response
ESOP-003	Equipment Fueling
ESOP-004	Fuel Transportation
ESOP-013	Waste Management
ESOP-022	Hach Turbidity Meter Use and Calibration
ESOP-023	Weed Management
ESOP-024	Herbicide Spill Response
ESOP-028	Spill Prevention, Control, and Countermeasure Plan (SPCC Plan)
ESOP-029	Stormwater Pollution Prevention Plan (SWPPP)
ESOP-034	Fueling Vehicle and Portable Containers

17. TRAINING

Employee and contractor training are an important part of the Environmental Protection Program. Pre-project briefings and tailgate sessions will be conducted to ensure that personnel and operators are aware of environmental standards and concerns during all phases of the ASAOC action. A log will be kept of all training sessions.

18. DOCUMENTATION

Perpetua has developed an environmental monitoring and documentation system that will support the ASAOC actions and ensure environmental protections are in place and current. All environmental protection records will be retained by Perpetua and available upon request.

19. REFERENCES

Bonneville Power Administration (BPA), 2014. Habitat Improvement Program Handbook. Abbreviated Guidance of General and Specific Conservation Measures, Biological Opinion Requirements and RRT Guidance.

Idaho Department of Environmental Quality (IDEQ), 2005. Catalog of Stormwater Best Management Practices for Idaho Cities and Counties. Water Quality Division. September 2005.

National Marine Fisheries Service (NMFS), 2019. Re-initiation of the Endangered Species Act Section 7(a)(2) Programmatic Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Consultation Habitat Restoration Projects in the Salmon River Basin (HUC 170602), Clearwater River Basin (HUC 170603), Hells Canyon Subbasin (HUC 17060101), and Lower Snake-Asotin Subbasin (HUC 17060103), Idaho NMFS Consultation Number: WCR-2018-9898. noaa_20696_DS1.pdf

National Marine Fisheries Service (NMFS), 2020. Endangered Species Act (ESA) Section 7(a)(2) Biological Opinion and Magnuson-Stevens Fishery Conservation and Management Act Essential Fish Habitat Response for the Payette National Forest, December 2020.

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U.S. Bureau of Reclamation (USBR), 2014. Pacific Northwest Region Resource & Technical Services Large Woody Material - Risk Based Design Guidelines. September 2014. Extracted 30 March 2021 https://www.usbr.gov/pn/fcrps/documents/lwm.pdf.

U.S. Environmental Protection Agency and U.S. Department of Agriculture Forest Service (EPA and USFS), 2021. Administrative Settlement Agreement and Order on Consent for Removal Actions, Stibnite Mine Site. CERCLA Docket No. 10-2021-0034.

U.S. Fish and Wildlife Service (USFWS), 2013. Formal section 7 programmatic consultation on BPA's Columbia River Basin Habitat Improvement Program. Oregon Fish and Wildlife Office, Portland, Oregon.

U.S. Forest Service (USFS), 2003. Final Forest Plan Revision Payette National Forest. July 2003.

U.S. Forest Service (USFS), 2007. South Fork Salmon River Sub Basin Noxious and Invasive Weed Management Program.

U.S. Forest Service (USFS), 2010. Payette National Forest Land Resource Management Plan.

Valley County, 2020. Road Maintenance Agreement for Yellow Pine to Stibnite Road. Cascade, Idaho.

Appendix A:
Valley County Road Maintenance Agreement

Stibnite Mine Site

Stibnite, Valley County, ID

Prepared for:

U.S. Environmental Protection Agency Region 10

United States Department of Agriculture Forest Service Intermountain Region

Prepared by:

Perpetua Resources

405 S 8th St,
Boise, ID, 83702

July 2021

Appendix B:

Catalog of Stormwater Best Management Practices

For Idaho Cities and Counties

Stibnite Mine Site

Stibnite, Valley County, ID

Prepared for:

U.S. Environmental Protection Agency Region 10

United States Department of Agriculture Forest Service Intermountain Region

Prepared by:

Perpetua Resources

405 S 8th St,
Boise, ID, 83702

July 2021

Appendix C:
Spill Prevention Control and Countermeasures Plan
(SPCC)

Stibnite Mine Site

Stibnite, Valley County, ID

Prepared for:

U.S. Environmental Protection Agency Region 10

United States Department of Agriculture Forest Service Intermountain Region

Prepared by:

Perpetua Resources

405 S 8th St,
Boise, ID, 83702

July 2021

Appendix D:

Comment Response Table

For Idaho Cities and Counties

Stibnite Mine Site

Stibnite, Valley County, ID

Prepared for:

U.S. Environmental Protection Agency Region 10

United States Department of Agriculture Forest Service Intermountain Region

Prepared by:

Perpetua Resources

405 S 8th St,
Boise, ID, 83702

July 2021